

# *Streptococcus pneumoniae* Antigens and Vaccines

## *Field of the Invention*

The present invention relates to novel *Streptococcus pneumoniae* antigens for the detection of *Streptococcus* and for the prevention or attenuation of disease caused by *Streptococcus*. The invention further relates to isolated nucleic acid molecules encoding antigenic polypeptides of *S. pneumoniae*. Antigenic polypeptides are also provided, as are vectors, host cells and recombinant methods for producing the same. The invention additionally relates to diagnostic methods for detecting *Streptococcus* gene expression.

## *Background of the Invention*

*Streptococcus pneumoniae* has been one of the most extensively studied microorganisms since its first isolation in 1881. It was the object of many investigations that led to important scientific discoveries. In 1928, Griffith observed that when heat-killed encapsulated pneumococci and live strains constitutively lacking any capsule were concomitantly injected into mice, the nonencapsulated could be converted into encapsulated pneumococci with the same capsular type as the heat-killed strain. Years later, the nature of this "transforming principle," or carrier of genetic information, was shown to be DNA. (Avery, O.T., *et al.*, *J. Exp. Med.*, 79:137-157 (1944)).

In spite of the vast number of publications on *S. pneumoniae* many questions about its virulence are still unanswered, and this pathogen remains a major causative agent of serious human disease, especially community-acquired pneumonia. (Johnston, R.B., *et al.*, *Rev. Infect. Dis.* 13(Suppl. 6):S509-517 (1991)). In addition, in developing countries, the pneumococcus is responsible for the death of a large number of children under the age of 5 years from pneumococcal pneumonia. The incidence of pneumococcal disease is highest in infants under 2 years of age and in people over 60 years of age. Pneumococci are the second most frequent cause (after *Haemophilus influenzae* type b) of bacterial meningitis and otitis media in children. With the recent introduction of conjugate vaccines for *H. influenzae* type b, pneumococcal meningitis is likely to become increasingly prominent. *S. pneumoniae* is the most important etiologic agent of community-acquired pneumonia in adults and is the second most common cause of bacterial meningitis behind *Neisseria meningitidis*.

The antibiotic generally prescribed to treat *S. pneumoniae* is benzylpenicillin, although resistance to this and to other antibiotics is found occasionally. Pneumococcal resistance to penicillin results from mutations in its

penicillin-binding proteins. In uncomplicated pneumococcal pneumonia caused by a sensitive strain, treatment with penicillin is usually successful unless started too late. Erythromycin or clindamycin can be used to treat pneumonia in patients hypersensitive to penicillin, but resistant strains to these drugs exist. Broad spectrum antibiotics (e.g., the tetracyclines) may also be effective, although tetracycline-resistant strains are not rare. In spite of the availability of antibiotics, the mortality of pneumococcal bacteremia in the last four decades has remained stable between 25 and 29%. (Gillespie, S.H., *et al.*, *J. Med. Microbiol.* 28:237-248 (1989).

*S. pneumoniae* is carried in the upper respiratory tract by many healthy individuals. It has been suggested that attachment of pneumococci is mediated by a disaccharide receptor on fibronectin, present on human pharyngeal epithelial cells. (Anderson, B.J., *et al.*, *J. Immunol.* 142:2464-2468 (1989). The mechanisms by which pneumococci translocate from the nasopharynx to the lung, thereby causing pneumonia, or migrate to the blood, giving rise to bacteremia or septicemia, are poorly understood. (Johnston, R.B., *et al.*, *Rev. Infect. Dis.* 13(Suppl. 6):S509-517 (1991).

Various proteins have been suggested to be involved in the pathogenicity of *S. pneumoniae*, however, only a few of them have actually been confirmed as virulence factors. Pneumococci produce an IgA1 protease that might interfere with host defense at mucosal surfaces. (Kornfield, S.J., *et al.*, *Rev. Inf. Dis.* 3:521-534 (1981). *S. pneumoniae* also produces neuraminidase, an enzyme that may facilitate attachment to epithelial cells by cleaving sialic acid from the host glycolipids and gangliosides. Partially purified neuraminidase was observed to induce meningitis-like symptoms in mice; however, the reliability of this finding has been questioned because the neuraminidase preparations used were probably contaminated with cell wall products. Other pneumococcal proteins besides neuraminidase are involved in the adhesion of pneumococci to epithelial and endothelial cells. These pneumococcal proteins have as yet not been identified. Recently, Cundell *et al.*, reported that peptide permeases can modulate pneumococcal adherence to epithelial and endothelial cells. It was, however, unclear whether these permeases function directly as adhesions or whether they enhance adherence by modulating the expression of pneumococcal adhesions. (DeVelasco, E.A., *et al.*, *Micro. Rev.* 59:591-603 (1995). A better understanding of the virulence factors determining its pathogenicity will need to be developed to cope with the devastating effects of pneumococcal disease in humans.

Ironically, despite the prominent role of *S. pneumoniae* in the discovery of DNA, little is known about the molecular genetics of the organism. The *S. pneumoniae* genome consists of one circular, covalently closed, double-stranded DNA and a collection of so-called variable accessory elements, such as prophages, plasmids, transposons and the like. Most physical characteristics and almost all of the genes of *S. pneumoniae* are unknown. Among the few that have been identified, most have not been physically mapped or characterized in detail. Only a few genes of this organism have been sequenced. (See, for instance current versions of GENBANK and other nucleic acid databases, and references that relate to the genome of *S. pneumoniae* such as those set out elsewhere herein.) Identification of *in vivo*-expressed, and broadly protective, antigens of *S. pneumoniae* has remained elusive.

#### **Summary of the Invention**

The present invention provides isolated nucleic acid molecules comprising polynucleotides encoding the *S. pneumoniae* polypeptides described in Table 1 and having the amino acid sequences shown as SEQ ID NO:2, SEQ ID NO:4, SEQ ID NO:6, and so on through SEQ ID NO:226. Thus, one aspect of the invention provides isolated nucleic acid molecules comprising polynucleotides having a nucleotide sequence selected from the group consisting of: (a) a nucleotide sequence encoding any of the amino acid sequences of the polypeptides shown in Table 1; and (b) a nucleotide sequence complementary to any of the nucleotide sequences in (a).

Further embodiments of the invention include isolated nucleic acid molecules that comprise a polynucleotide having a nucleotide sequence at least 90% identical, and more preferably at least 95%, 96%, 97%, 98% or 99% identical, to any of the nucleotide sequences in (a) or (b) above, or a polynucleotide which hybridizes under stringent hybridization conditions to a polynucleotide in (a) or (b) above. This polynucleotide which hybridizes does not hybridize under stringent hybridization conditions to a polynucleotide having a nucleotide sequence consisting of only A residues or of only T residues. Additional nucleic acid embodiments of the invention relate to isolated nucleic acid molecules comprising polynucleotides which encode the amino acid sequences of epitope-bearing portions of an *S. pneumoniae* polypeptide having an amino acid sequence in (a) above.

The present invention also relates to recombinant vectors, which include the isolated nucleic acid molecules of the present invention, and to host cells containing the recombinant vectors, as well as to methods of making such

vectors and host cells and for using these vectors for the production of *S. pneumoniae* polypeptides or peptides by recombinant techniques.

The invention further provides isolated *S. pneumoniae* polypeptides having an amino acid sequence selected from the group consisting of an amino acid sequence of any of the polypeptides described in Table 1.

The polypeptides of the present invention also include polypeptides having an amino acid sequence with at least 70% similarity, and more preferably at least 75%, 80%, 85%, 90%, 95%, 96%, 97%, 98%, or 99% similarity to those described in Table 1, as well as polypeptides having an amino acid sequence at least 70% identical, more preferably at least 75% identical, and still more preferably 80%, 85%, 90%, 95%, 96%, 97%, 98%, or 99% identical to those above; as well as isolated nucleic acid molecules encoding such polypeptides.

The present invention further provides a vaccine, preferably a multi-component vaccine comprising one or more of the *S. pneumoniae* polynucleotides or polypeptides described in Table 1, or fragments thereof, together with a pharmaceutically acceptable diluent, carrier, or excipient, wherein the *S. pneumoniae* polypeptide(s) are present in an amount effective to elicit an immune response to members of the *Streptococcus* genus in an animal. The *S. pneumoniae* polypeptides of the present invention may further be combined with one or more immunogens of one or more other streptococcal or non-streptococcal organisms to produce a multi-component vaccine intended to elicit an immunological response against members of the *Streptococcus* genus and, optionally, one or more non-streptococcal organisms.

The vaccines of the present invention can be administered in a DNA form, e.g., "naked" DNA, wherein the DNA encodes one or more streptococcal polypeptides and, optionally, one or more polypeptides of a non-streptococcal organism. The DNA encoding one or more polypeptides may be constructed such that these polypeptides are expressed fusion proteins.

The vaccines of the present invention may also be administered as a component of a genetically engineered organism. Thus, a genetically engineered organism which expresses one or more *S. pneumoniae* polypeptides may be administered to an animal. For example, such a genetically engineered organism may contain one or more *S. pneumoniae* polypeptides of the present invention intracellularly, on its cell surface, or in its periplasmic space. Further, such a genetically engineered organism may secrete one or more *S. pneumoniae* polypeptides.



The vaccines of the present invention may be co-administered to an animal with an immune system modulator (e.g., CD86 and GM-CSF).

The invention also provides a method of inducing an immunological response in an animal to one or more members of the *Streptococcus* genus, preferably one or more isolates of the *S. pneumoniae* genus, comprising administering to the animal a vaccine as described above.

The invention further provides a method of inducing a protective immune response in an animal, sufficient to prevent or attenuate an infection by members of the *Streptococcus* genus, preferably at least *S. pneumoniae*, comprising administering to the animal a composition comprising one or more of the polynucleotides or polypeptides described in Table 1, or fragments thereof. Further, these polypeptides, or fragments thereof, may be conjugated to another immunogen and/or administered in admixture with an adjuvant.

The invention further relates to antibodies elicited in an animal by the administration of one or more *S. pneumoniae* polypeptides of the present invention and to methods for producing such antibodies.

The invention also provides diagnostic methods for detecting the expression of genes of members of the *Streptococcus* genus in an animal. One such method involves assaying for the expression of a gene encoding *S. pneumoniae* peptides in a sample from an animal. This expression may be assayed either directly (e.g., by assaying polypeptide levels using antibodies elicited in response to amino acid sequences described in Table 1) or indirectly (e.g., by assaying for antibodies having specificity for amino acid sequences described in Table 1). An example of such a method involves the use of the polymerase chain reaction (PCR) to amplify and detect *Streptococcus* nucleic acid sequences.

The present invention also relates to nucleic acid probes having all or part of a nucleotide sequence described in Table 1 (shown as SEQ ID NO:1, SEQ ID NO:3, SEQ ID NO:5, and so on through SEQ ID NO:225) which are capable of hybridizing under stringent conditions to *Streptococcus* nucleic acids. The invention further relates to a method of detecting one or more *Streptococcus* nucleic acids in a biological sample obtained from an animal, said one or more nucleic acids encoding *Streptococcus* polypeptides, comprising: (a) contacting the sample with one or more of the above-described nucleic acid probes, under conditions such that hybridization occurs, and (b) detecting hybridization of said one or more probes to the *Streptococcus* nucleic acid present in the biological sample.

The invention also includes immunoassays, including an immunoassay for detecting *Streptococcus*, preferably at least isolates of the *S. pneumoniae* genus, comprising incubation of a sample (which is suspected of being infected with *Streptococcus*) with a probe antibody directed against an antigen/epitope of *S. pneumoniae*, to be detected under conditions allowing the formation of an antigen-antibody complex; and detecting the antigen-antibody complex which contains the probe antibody. An immunoassay for the detection of antibodies which are directed against a *Streptococcus* antigen comprising the incubation of a sample (containing antibodies from a mammal suspected of being infected with *Streptococcus*) with a probe polypeptide including an epitope of *S. pneumoniae*, under conditions that allow the formation of antigen-antibody complexes which contain the probe epitope containing antigen.

Some aspects of the invention pertaining to kits are those for: investigating samples for the presence of polynucleotides derived from *Streptococcus* which comprise a polynucleotide probe including a nucleotide sequence selected from Table 1 or a fragment thereof of approximately 15 or more nucleotides, in an appropriate container; analyzing the samples for the presence of antibodies directed against a *Streptococcus* antigen made up of a polypeptide which contains a *S. pneumoniae* epitope present in the polypeptide, in a suitable container; and analyzing samples for the presence of *Streptococcus* antigens made up of an anti-*S. pneumoniae* antibody, in a suitable container.

### **Detailed Description**

The present invention relates to recombinant antigenic *S. pneumoniae* polypeptides and fragments thereof. The invention also relates to methods for using these polypeptides to produce immunological responses and to confer immunological protection to disease caused by members of the genus *Streptococcus*, at least isolates of the *S. pneumoniae* genus. The invention further relates to nucleic acid sequences which encode antigenic *S. pneumoniae* polypeptides and to methods for detecting *S. pneumoniae* nucleic acids and polypeptides in biological samples. The invention also relates to *S. pneumoniae*-specific antibodies and methods for detecting such antibodies produced in a host animal.

### **Definitions**

The following definitions are provided to clarify the subject matter which the inventors consider to be the present invention.

As used herein, the phrase "pathogenic agent" means an agent which causes a disease state or affliction in an animal. Included within this definition, for examples, are bacteria, protozoans, fungi, viruses and metazoan parasites which either produce a disease state or render an animal infected with such an organism susceptible to a disease state (e.g., a secondary infection). Further included are species and strains of the genus *Streptococcus* which produce disease states in animals.

As used herein, the term "organism" means any living biological system, including viruses, regardless of whether it is a pathogenic agent.

As used herein, the term "*Streptococcus*" means any species or strain of bacteria which is members of the genus *Streptococcus*. Such species and strains are known to those of skill in the art, and include those that are pathogenic and those that are not.

As used herein, the phrase "one or more *S. pneumoniae* polypeptides of the present invention" means polypeptides comprising the amino acid sequence of one or more of the *S. pneumoniae* polypeptides described in Table 1 and disclosed as SEQ ID NO:2, SEQ ID NO:4, SEQ ID NO:6, and so on through SEQ ID NO:226. These polypeptides may be expressed as fusion proteins wherein the *S. pneumoniae* polypeptides of the present invention are linked to additional amino acid sequences which may be of streptococcal or non-streptococcal origin. This phrase further includes polypeptide comprising fragments of the *S. pneumoniae* polypeptides of the present invention.

Additional definitions are provided throughout the specification.

### ***Explanation of Table 1***

Table 1, below, provides information describing 113 open reading frames (ORFs) which encode potentially antigenic polypeptides of *S. pneumoniae* of the present invention. The table lists the ORF identifier which consists of the letters SP, which denote *S. pneumoniae*, followed immediately by a three digit numeric code, which arbitrarily number the potentially antigenic polypeptides of *S. pneumoniae* of the present invention and the nucleotide or amino acid sequence of each ORF and encoded polypeptide. The table further correlates the ORF identifier with a sequence identification number (SEQ ID NO:). The actual nucleotide or amino acid sequence of each ORF identifier is also shown in the Sequence Listing under the corresponding SEQ ID NO.

Thus, for example, the designation "SP126" refers to both the nucleotide and amino acid sequences of *S. pneumoniae* polypeptide number 126 of the present invention. Further, "SP126" correlates with the nucleotide

sequence shown as SEQ ID NO:223 and with the amino acid sequence shown as SEQ ID NO:224 as is described in Table 1.

The open reading frame within each "ORF" begins with the second nucleotide shown. Thus, the first codon for each nucleotide sequence shown is bases 2-4, the second 5-7, the third 8-10, and so on.

### ***Explanation of Table 2***

Table 2 lists the antigenic epitopes present in each of the *S. pneumoniae* polypeptides described in Table 1 as predicted by the inventors. Each *S. pneumoniae* polypeptide shown in Table 1 has one or more antigenic epitopes described in Table 2. It will be appreciated that depending on the analytical criteria used to predict antigenic determinants, the exact address of the determinant may vary slightly. The exact location of the antigenic determinant may shift by about 1 to 5 residues, more likely 1 to 2 residues, depending on the criteria used. Thus, the first antigenic determinant described in Table 2, "Lys-1 to Ile-10" of SP001, represents a peptide comprising the lysine at position 1 in SEQ ID NO:2 through and including the isoleucine at position 10 in SEQ ID NO:2, but may include more or fewer residues than those 10. It will also be appreciated that, generally speaking, amino acids can be added to either terminus of a peptide or polypeptide containing an antigenic epitope without affecting its activity, whereas removing residues from a peptide or polypeptide containing only the antigenic determinant is much more likely to destroy activity. It will be appreciated that the residues and locations shown described in Table 2 correspond to the amino acid sequences for each ORF shown in Table 1 and in the Sequence Listing.

### ***Explanation of Table 3***

Table 3 shows PCR primers designed by the inventors for the amplification of polynucleotides encoding polypeptides of the present invention according to the method of Example 1. PCR primer design is routine in the art and those shown in Table 3 are provided merely for the convenience of the skilled artisan. It will be appreciated that others can be used with equal success.

For each primer, the table lists the corresponding ORF designation from Table 1 followed by either an "A" or a "B". The "A" primers are the 5' primers and the "B" primers 3'. A restriction enzyme site was built into each primer to allow ease of cloning. The restriction enzyme which will recognize and cleave a sequence within each primer is shown in Table 3, as well, under the heading

"RE" for restriction enzyme. Finally the sequence identifier is shown in Table 3 for each primer for easy correlation with the Sequence Listing.

### *Selection of Nucleic Acid Sequences Encoding Antigenic S. pneumoniae Polypeptides*

The present invention provides a select number of ORFs from those presented in the fragments of the *S. pneumoniae* genome which may prove useful for the generation of a protective immune response. The sequenced *S. pneumoniae* genomic DNA was obtained from a sub-cultured isolate of *S. pneumoniae* Strain 7/87 14.8.91, which has been deposited at the American Type Culture Collection, as a convenience to those of skill in the art. The *S. pneumoniae* isolate was deposited on October 10, 1996 at the ATCC, 12301 Park Lawn Drive, Rockville, Maryland 20852, and given accession number 55840. A genomic library constructed from DNA isolated from the *S. pneumoniae* isolate was also deposited at the ATCC on October 11, 1996 and given ATCC Deposit No. 97755. A more complete listing of the sequence obtained from the *S. pneumoniae* genome may be found in co-pending U.S. Provisional Application Serial No. 60/029,960, filed 10/31/96, incorporated herein by reference in its entirety. Some ORFs contained in the subset of fragments of the *S. pneumoniae* genome disclosed herein were derived through the use of a number of screening criteria detailed below.

The selected ORFs do not consist of complete ORFs. Although a polypeptide representing a complete ORF may be the closest approximation of a protein native to an organism, it is not always preferred to express a complete ORF in a heterologous system. It may be challenging to express and purify a highly hydrophobic protein by common laboratory methods. Thus, the polypeptide vaccine candidates described herein may have been modified slightly to simplify the production of recombinant protein. For example, nucleotide sequences which encode highly hydrophobic domains, such as those found at the amino terminal signal sequence, have been excluded from some constructs used for *in vitro* expression of the polypeptides. Furthermore, any highly hydrophobic amino acid sequences occurring at the carboxy terminus have also been excluded from the recombinant expression constructs. Thus, in one embodiment, a polypeptide which represents a truncated or modified ORF may be used as an antigen.

While numerous methods are known in the art for selecting potentially immunogenic polypeptides, many of the ORFs disclosed herein were selected

on the basis of screening all theoretical *S. pneumoniae* ORFs for several aspects of potential immunogenicity. One set of selection criteria are as follows:

1. *Type I signal sequence*: An amino terminal type I signal sequence generally directs a nascent protein across the plasma and outer membranes to the exterior of the bacterial cell. Experimental evidence obtained from studies with *Escherichia coli* suggests that the typical type I signal sequence consists of the following biochemical and physical attributes (Izard, J. W. and Kendall, D. A. *Mol. Microbiol.* 13:765-773 (1994)). The length of the type I signal sequence is approximately 15 to 25 primarily hydrophobic amino acid residues with a net positive charge in the extreme amino terminus. In addition, the central region of the signal sequence adopts an alpha-helical conformation in a hydrophobic environment. Finally, the region surrounding the actual site of cleavage is ideally six residues long, with small side-chain amino acids in the -1 and -3 positions.

2. *Type IV signal sequence*: The type IV signal sequence is an example of the several types of functional signal sequences which exist in addition to the type I signal sequence detailed above. Although functionally related, the type IV signal sequence possesses a unique set of biochemical and physical attributes (Strom, M. S. and Lory, S., *J. Bacteriol.* 174:7345-7351 (1992)). These are typically six to eight amino acids with a net basic charge followed by an additional sixteen to thirty primarily hydrophobic residues. The cleavage site of a type IV signal sequence is typically after the initial six to eight amino acids at the extreme amino terminus. In addition, type IV signal sequences generally contain a phenylalanine residue at the +1 site relative to the cleavage site.

3. ~~*Lipoprotein*~~: ~~Studies of the cleavage sites of twenty-six bacterial lipoprotein precursors has allowed the definition of a consensus amino acid sequence for lipoprotein cleavage. Nearly three-fourths of the bacterial lipoprotein precursors examined contained the sequence L-(A,S)-(G,A)-C at positions -3 to +1, relative to the point of cleavage (Hayashi, S. and Wu, H. C., *J. Bioenerg. Biomembr.* 22:451-471 (1990)).~~

4. ~~*LPXTG motif*~~: ~~It has been experimentally determined that most~~ anchored proteins found on the surface of gram-positive bacteria possess a highly conserved carboxy terminal sequence. More than fifty such proteins from organisms such as *S. pyogenes*, *S. mutans*, *E. faecalis*, *S. pneumoniae*, and others, have been identified based on their extracellular location and carboxy terminal amino acid sequence (Fischetti, V. A., *ASM News* 62:405-410 (1996)). The conserved region consists of six charged-amino-acids at the extreme carboxy terminus coupled to 15-20 hydrophobic amino acids

presumed to function as a transmembrane domain. Immediately adjacent to the transmembrane domain is a six amino acid sequence conserved in nearly all proteins examined. The amino acid sequence of this region is L-P-X-T-G-X, where X is any amino acid.

5 An algorithm for selecting antigenic and immunogenic *S. pneumoniae* polypeptides including the foregoing criteria was developed. Use of the algorithm by the inventors to select immunologically useful *S. pneumoniae* polypeptides resulted in the selection of a number of the disclosed ORFs. Polypeptides comprising the polypeptides identified in this group may be  
10 produced by techniques standard in the art and as further described herein.

### ***Nucleic Acid Molecules***

The present invention provides isolated nucleic acid molecules comprising polynucleotides encoding the *S. pneumoniae* polypeptides having the amino acid sequences described in Table 1 and shown as SEQ ID NO:2, SEQ ID NO:4, SEQ ID NO:6, and so on through SEQ ID NO:226, which were determined by sequencing the genome of *S. pneumoniae* and selected as putative immunogens.  
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Unless otherwise indicated, all nucleotide sequences determined by sequencing a DNA molecule herein were determined using an automated DNA sequencer (such as the Model 373 from Applied Biosystems, Inc.), and all amino acid sequences of polypeptides encoded by DNA molecules determined herein were predicted by translation of DNA sequences determined as above. Therefore, as is known in the art for any DNA sequence determined by this automated approach, any nucleotide sequence determined herein may contain some errors. Nucleotide sequences determined by automation are typically at least about 90% identical, more typically at least about 95% to at least about 99.9% identical to the actual nucleotide sequence of the sequenced DNA molecule. The actual sequence can be more precisely determined by other approaches including manual DNA sequencing methods well known in the art. As is also known in the art, a single insertion or deletion in a determined nucleotide sequence compared to the actual sequence will cause a frame shift in translation of the nucleotide sequence such that the predicted amino acid sequence encoded by a determined nucleotide sequence will be completely different from the amino acid sequence actually encoded by the sequenced DNA molecule, beginning at the point of such an insertion or deletion.  
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Unless otherwise indicated, each "nucleotide sequence" set forth herein is presented as a sequence of deoxyribonucleotides (abbreviated A, G, C and

T). However, by "nucleotide sequence" of a nucleic acid molecule or polynucleotide is intended, for a DNA molecule or polynucleotide, a sequence of deoxyribonucleotides, and for an RNA molecule or polynucleotide, the corresponding sequence of ribonucleotides (A, G, C and U), where each thymidine deoxyribonucleotide (T) in the specified deoxyribonucleotide sequence is replaced by the ribonucleotide uridine (U). For instance, reference to an RNA molecule having a sequence described in Table 1 set forth using deoxyribonucleotide abbreviations is intended to indicate an RNA molecule having a sequence in which each deoxyribonucleotide A, G or C described in Table 1 has been replaced by the corresponding ribonucleotide A, G or C, and each deoxyribonucleotide T has been replaced by a ribonucleotide U.

Nucleic acid molecules of the present invention may be in the form of RNA, such as mRNA, or in the form of DNA, including, for instance, cDNA and genomic DNA obtained by cloning or produced synthetically. The DNA may be double-stranded or single-stranded. Single-stranded DNA or RNA may be the coding strand, also known as the sense strand, or it may be the non-coding strand, also referred to as the anti-sense strand.

By "isolated" nucleic acid molecule(s) is intended a nucleic acid molecule, DNA or RNA, which has been removed from its native environment. For example, recombinant DNA molecules contained in a vector are considered isolated for the purposes of the present invention. Further examples of isolated DNA molecules include recombinant DNA molecules maintained in heterologous host cells or purified (partially or substantially) DNA molecules in solution. Isolated RNA molecules include *in vivo* or *in vitro* RNA transcripts of the DNA molecules of the present invention. Isolated nucleic acid molecules according to the present invention further include such molecules produced synthetically.

Isolated nucleic acid molecules of the present invention include DNA molecules comprising a nucleotide sequence described in Table 1 and shown as SEQ ID NO:1, SEQ ID NO:3, SEQ ID NO:5, and so on through SEQ ID NO:225; DNA molecules comprising the coding sequences for the polypeptides described in Table 1 and shown as SEQ ID NO:2, SEQ ID NO:4, SEQ ID NO:6, and so on through SEQ ID NO:226; and DNA molecules which comprise sequences substantially different from those described above but which, due to the degeneracy of the genetic code, still encode the *S. pneumoniae* polypeptides described in Table 1. Of course, the genetic code is well known in the art. Thus, it would be routine for one skilled in the art to generate such degenerate variants.



The invention also provides nucleic acid molecules having sequences complementary to any one of those described in Table 1. Such isolated molecules, particularly DNA molecules, are useful as probes for detecting expression of *Streptococcal* genes, for instance, by Northern blot analysis or the polymerase chain reaction (PCR).

The present invention is further directed to fragments of the isolated nucleic acid molecules described herein. By a fragment of an isolated nucleic acid molecule having a nucleotide sequence described in Table 1, is intended fragments at least about 15 nt, and more preferably at least about 17 nt, still more preferably at least about 20 nt, and even more preferably, at least about 25 nt in length which are useful as diagnostic probes and primers as discussed herein. Of course, larger fragments 50-100 nt in length are also useful according to the present invention as are fragments corresponding to most, if not all, of a nucleotide sequence described in Table 1. By a fragment at least 20 nt in length, for example, is intended fragments which include 20 or more contiguous bases of a nucleotide sequence as described in Table 1. Since the nucleotide sequences identified in Table 1 are provided as SEQ ID NO:1, SEQ ID NO:3, SEQ ID NO:5, and so on through SEQ ID NO:225, generating such DNA fragments would be routine to the skilled artisan. For example, such fragments could be generated synthetically.

Preferred nucleic acid fragments of the present invention also include nucleic acid molecules comprising nucleotide sequences encoding epitope-bearing portions of the *S. pneumoniae* polypeptides identified in Table 1. Such nucleic acid fragments of the present invention include, for example, nucleotide sequences encoding polypeptide fragments comprising from about the amino terminal residue to about the carboxy terminal residue of each fragment shown in Table 2. The above referred to polypeptide fragments are antigenic regions of the *S. pneumoniae* polypeptides identified in Table 1.

In another aspect, the invention provides isolated nucleic acid molecules comprising polynucleotides which hybridize under stringent hybridization conditions to a portion of a polynucleotide in a nucleic acid molecule of the invention described above, for instance, a nucleic acid sequence identified in Table 1. By "stringent hybridization conditions" is intended overnight incubation at 42°C in a solution comprising: 50% formamide, 5x SSC (150 mM NaCl, 15 mM trisodium citrate), 50 mM sodium phosphate (pH 7.6), 5x Denhardt's solution, 10% dextran sulfate, and 20 g/ml denatured, sheared salmon sperm DNA, followed by washing the filters in 0.1x SSC at about 65°C.

By polynucleotides which hybridize to a "portion" of a polynucleotide is intended polynucleotides (either DNA or RNA) which hybridize to at least about 15 nucleotides (nt), and more preferably at least about 17 nt, still more preferably at least about 20 nt, and even more preferably about 25-70 nt of the reference polynucleotide. These are useful as diagnostic probes and primers as discussed above and in more detail below.

Of course, polynucleotides hybridizing to a larger portion of the reference polynucleotide, for instance, a portion 50-100 nt in length, or even to the entire length of the reference polynucleotide, are also useful as probes according to the present invention, as are polynucleotides corresponding to most, if not all, of a nucleotide sequence as identified in Table 1. By a portion of a polynucleotide of "at least 20 nt in length," for example, is intended 20 or more contiguous nucleotides from the nucleotide sequence of the reference polynucleotide (e.g., a nucleotide sequences as described in Table 1). As noted above, such portions are useful diagnostically either as probes according to conventional DNA hybridization techniques or as primers for amplification of a target sequence by PCR, as described in the literature (for instance, in *Molecular Cloning, A Laboratory Manual*, 2nd. edition, Sambrook, J., Fritsch, E. F. and Maniatis, T., eds., Cold Spring Harbor Laboratory Press, Cold Spring Harbor, N.Y. (1989), the entire disclosure of which is hereby incorporated herein by reference).

Since nucleic acid sequences encoding the *S. pneumoniae* polypeptides of the present invention are identified in Table 1 and provided as SEQ ID NO:1, SEQ ID NO:3, SEQ ID NO:5, and so on through SEQ ID NO:225, generating polynucleotides which hybridize to portions of these sequences would be routine to the skilled artisan. For example, the hybridizing polynucleotides of the present invention could be generated synthetically according to known techniques.

As indicated, nucleic acid molecules of the present invention which encode *S. pneumoniae* polypeptides of the present invention may include, but are not limited to those encoding the amino acid sequences of the polypeptides by themselves; and additional coding sequences which code for additional amino acids, such as those which provide additional functionalities. Thus, the sequences encoding these polypeptides may be fused to a marker sequence, such as a sequence encoding a peptide which facilitates purification of the fused polypeptide. In certain preferred embodiments of this aspect of the invention, the marker amino acid sequence is a hexa-histidine peptide, such as the tag provided in a pQE vector (Qiagen, Inc.), among others, many of which are

commercially available. As described by Gentz and colleagues (*Proc. Natl. Acad. Sci. USA* **86**:821-824 (1989)), for instance, hexa-histidine provides for convenient purification of the resulting fusion protein.

Thus, the present invention also includes genetic fusions wherein the *S. pneumoniae* nucleic acid sequences coding sequences identified in Table 1 are linked to additional nucleic acid sequences to produce fusion proteins. These fusion proteins may include epitopes of streptococcal or non-streptococcal origin designed to produce proteins having enhanced immunogenicity. Further, the fusion proteins of the present invention may contain antigenic determinants known to provide helper T-cell stimulation, peptides encoding sites for post-translational modifications which enhance immunogenicity (*e.g.*, acylation), peptides which facilitate purification (*e.g.*, histidine "tag"), or amino acid sequences which target the fusion protein to a desired location (*e.g.*, a heterologous leader sequence).

In all cases of bacterial expression, an N-terminal methionine residues is added. In many cases, however, the N-terminal methionine residues is cleaved off post-translationally. Thus, the invention includes polypeptides shown in Table 1 with, and without an N-terminal methionine.

The present invention thus includes nucleic acid molecules and sequences which encode fusion proteins comprising one or more *S. pneumoniae* polypeptides of the present invention fused to an amino acid sequence which allows for post-translational modification to enhance immunogenicity. This post-translational modification may occur either *in vitro* or when the fusion protein is expressed *in vivo* in a host cell. An example of such a modification is the introduction of an amino acid sequence which results in the attachment of a lipid moiety.

Thus, as indicated above, the present invention includes genetic fusions wherein a *S. pneumoniae* nucleic acid sequence identified in Table 1 is linked to a nucleotide sequence encoding another amino acid sequence. These other amino acid sequences may be of streptococcal origin (*e.g.*, another sequence selected from Table 1) or non-streptococcal origin.

The present invention further relates to variants of the nucleic acid molecules of the present invention, which encode portions, analogs or derivatives of the *S. pneumoniae* polypeptides described in Table 1. Variants may occur naturally, such as a natural allelic variant. By an "allelic variant" is intended one of several alternate forms of a gene occupying a given locus on a chromosome of an organism (*Genes II*, Lewin, B., ed., John Wiley & Sons,

New York (1985)). Non-naturally occurring variants may be produced using art-known mutagenesis techniques.

Such variants include those produced by nucleotide substitutions, deletions or additions. The substitutions, deletions or additions may involve one or more nucleotides. These variants may be altered in coding regions, non-coding regions, or both. Alterations in the coding regions may produce conservative or non-conservative amino acid substitutions, deletions or additions. Especially preferred among these are silent substitutions, additions and deletions, which do not alter the properties and activities of the *S. pneumoniae* polypeptides disclosed herein or portions thereof. Silent substitution are most likely to be made in non-epitopic regions. Guidance regarding those regions containing epitopes is provided herein, for example, in Table 2. Also especially preferred in this regard are conservative substitutions.

Further embodiments of the invention include isolated nucleic acid molecules comprising a polynucleotide having a nucleotide sequence at least 90% identical, and more preferably at least 95%, 96%, 97%, 98% or 99% identical to: (a) a nucleotide sequence encoding any of the amino acid sequences of the polypeptides identified in Table 1; and (b) a nucleotide sequence complementary to any of the nucleotide sequences in (a) above.

By a polynucleotide having a nucleotide sequence at least, for example, 95% "identical" to a reference nucleotide sequence encoding a *S. pneumoniae* polypeptide described in Table 1, is intended that the nucleotide sequence of the polynucleotide is identical to the reference sequence except that the polynucleotide sequence may include up to five point mutations per each 100 nucleotides of the reference nucleotide sequence encoding the subject *S. pneumoniae* polypeptide. In other words, to obtain a polynucleotide having a nucleotide sequence at least 95% identical to a reference nucleotide sequence, up to 5% of the nucleotides in the reference sequence may be deleted or substituted with another nucleotide, or a number of nucleotides up to 5% of the total nucleotides in the reference sequence may be inserted into the reference sequence. These mutations of the reference sequence may occur at the 5' or 3' terminal positions of the reference nucleotide sequence or anywhere between those terminal positions, interspersed either individually among nucleotides in the reference sequence or in one or more contiguous groups within the reference sequence.

Certain nucleotides within some of the nucleic acid sequences shown in Table 1 were ambiguous upon sequencing. Completely unknown sequences are shown as an "N". Other unresolved nucleotides are known to be either a

purine, shown as "R", or a pyrimidine, shown as "Y". Accordingly, when determining identity between two nucleotide sequences, identity is met where any nucleotide, including an "R", "Y" or "N", is found in a test sequence and at the corresponding position in the reference sequence (from Table 1). Likewise, an A, G or "R" in a test sequence is identical to an "R" in the reference sequence; and a T, C or "Y" in a test sequence is identical to a "Y" in the reference sequence.

As a practical matter, whether any particular nucleic acid molecule is at least 90%, 95%, 96%, 97%, 98% or 99% identical to, for instance, a nucleotide sequence described in Table 1 can be determined conventionally using known computer programs such as the Bestfit program (Wisconsin Sequence Analysis Package, Version 8 for Unix, Genetics Computer Group, University Research Park, 575 Science Drive, Madison, WI 53711). Bestfit uses the local homology algorithm of Smith and Waterman (*Advances in Applied Mathematics* 2:482-489 (1981)), to find the best segment of homology between two sequences. When using Bestfit or any other sequence alignment program to determine whether a particular sequence is, for instance, 95% identical to a reference sequence according to the present invention, the parameters are set, of course, such that the percentage of identity is calculated over the full length of the reference nucleotide sequence and that gaps in homology of up to 5% of the total number of nucleotides in the reference sequence are allowed.

The present application is directed to nucleic acid molecules at least 90%, 95%, 96%, 97%, 98% or 99% identical to a nucleic acid sequences described in Table 1. One of skill in the art would still know how to use the nucleic acid molecule, for instance, as a hybridization probe or a polymerase chain reaction (PCR) primer. Uses of the nucleic acid molecules of the present invention include, *inter alia*, (1) isolating *Streptococcal* genes or allelic variants thereof from either a genomic or cDNA library and (2) Northern Blot or PCR analysis for detecting *Streptococcal* mRNA expression.

Of course, due to the degeneracy of the genetic code, one of ordinary skill in the art will immediately recognize that a large number of nucleic acid molecules having a sequence at least 90%, 95%, 96%, 97%, 98%, or 99% identical to a nucleic acid sequence identified in Table 1 will encode the same polypeptide. In fact, since degenerate variants of these nucleotide sequences all encode the same polypeptide, this will be clear to the skilled artisan even without performing the above described comparison assay.

It will be further recognized in the art that, for such nucleic acid molecules that are not degenerate variants, a reasonable number will also encode

proteins having antigenic epitopes of the *S. pneumoniae* polypeptides of the present invention. This is because the skilled artisan is fully aware of amino acid substitutions that are either less likely or not likely to significantly effect the antigenicity of a polypeptide (e.g., replacement of an amino acid in a region which is not believed to form an antigenic epitope). For example, since antigenic epitopes have been identified which contain as few as six amino acids (see Harlow, *et al.*, *Antibodies: A Laboratory Manual*, 2nd Ed.; Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York (1988), page 76), in instances where a polypeptide has multiple antigenic epitopes the alteration of several amino acid residues would often not be expected to eliminate all of the antigenic epitopes of that polypeptide. This is especially so when the alterations are in regions believed to not constitute antigenic epitopes.

### **Vectors and Host Cells**

The present invention also relates to vectors which include the isolated DNA molecules of the present invention, host cells which are genetically engineered with the recombinant vectors, and the production of *S. pneumoniae* polypeptides or fragments thereof by recombinant techniques.

Recombinant constructs may be introduced into host cells using well known techniques such as infection, transduction, transfection, transvection, electroporation and transformation. The vector may be, for example, a phage, plasmid, viral or retroviral vector. Retroviral vectors may be replication competent or replication defective. In the latter case, viral propagation generally will occur only in complementing host cells.

The polynucleotides may be joined to a vector containing a selectable marker for propagation in a host. Generally, a plasmid vector is introduced in a precipitate, such as a calcium phosphate precipitate, or in a complex with a charged lipid. If the vector is a virus, it may be packaged *in vitro* using an appropriate packaging cell line and then transduced into host cells.

Preferred are vectors comprising *cis*-acting control regions to the polynucleotide of interest. Appropriate *trans*-acting factors may be supplied by the host, supplied by a complementing vector or supplied by the vector itself upon introduction into the host.

In certain preferred embodiments in this regard, the vectors provide for specific expression, which may be inducible and/or cell type-specific. Particularly preferred among such vectors are those inducible by environmental factors that are easy to manipulate, such as temperature and nutrient additives.

Expression vectors useful in the present invention include chromosomal-, episomal- and virus-derived vectors, *e.g.*, vectors derived from bacterial plasmids, bacteriophage, yeast episomes, yeast chromosomal elements, viruses such as baculoviruses, papova viruses, vaccinia viruses, adenoviruses, fowl pox viruses, pseudorabies viruses and retroviruses, and vectors derived from combinations thereof, such as cosmids and phagemids.

The DNA insert should be operatively linked to an appropriate promoter, such as the phage lambda PL promoter, the *E. coli lac*, *trp* and *tac* promoters, the SV40 early and late promoters and promoters of retroviral LTRs, to name a few. Other suitable promoters will be known to the skilled artisan. The expression constructs will further contain sites for transcription initiation, termination and, in the transcribed region, a ribosome binding site for translation. The coding portion of the mature transcripts expressed by the constructs will preferably include a translation initiating site at the beginning and a termination codon (UAA, UGA or UAG) appropriately positioned at the end of the polypeptide to be translated.

As indicated, the expression vectors will preferably include at least one selectable marker. Such markers include dihydrofolate reductase or neomycin resistance for eukaryotic cell culture and tetracycline or ampicillin resistance genes for culturing in *E. coli* and other bacteria. Representative examples of appropriate hosts include, but are not limited to, bacterial cells, such as *E. coli*, *Streptomyces* and *Salmonella typhimurium* cells; fungal cells, such as yeast cells; insect cells such as *Drosophila* S2 and *Spodoptera* Sf9 cells; animal cells such as CHO, COS and Bowes melanoma cells; and plant cells. Appropriate culture mediums and conditions for the above-described host cells are known in the art.

Among vectors preferred for use in bacteria include pQE70, pQE60 and pQE-9, available from Qiagen; pBS vectors, Phagescript vectors, Bluescript vectors, pNH8A, pNH16a, pNH18A, pNH46A available from Stratagene; pET series of vectors available from Novagen; and ptrc99a, pKK223-3, pKK233-3, pDR540, pRIT5 available from Pharmacia. Among preferred eukaryotic vectors are pWLNEO, pSV2CAT, pOG44, pXT1 and pSG available from Stratagene; and pSVK3, pBPV, pMSG and pSVL available from Pharmacia. Other suitable vectors will be readily apparent to the skilled artisan.

Among known bacterial promoters suitable for use in the present invention include the *E. coli lacI* and *lacZ* promoters, the T3 and T7 promoters, the *gpt* promoter, the lambda PR and PL promoters and the *trp* promoter. Suitable eukaryotic promoters include the CMV immediate early promoter, the

HSV thymidine kinase promoter, the early and late SV40 promoters, the promoters of retroviral LTRs, such as those of the Rous sarcoma virus (RSV), and metallothionein promoters, such as the mouse metallothionein-I promoter.

Introduction of the construct into the host cell can be effected by calcium phosphate transfection, DEAE-dextran mediated transfection, cationic lipid-mediated transfection, electroporation, transduction, infection or other methods. Such methods are described in many standard laboratory manuals (for example, Davis, *et al.*, *Basic Methods In Molecular Biology* (1986)).

Transcription of DNA encoding the polypeptides of the present invention by higher eukaryotes may be increased by inserting an enhancer sequence into the vector. Enhancers are *cis*-acting elements of DNA, usually about from 10 to 300 bp that act to increase transcriptional activity of a promoter in a given host cell-type. Examples of enhancers include the SV40 enhancer, which is located on the late side of the replication origin at bp 100 to 270, the cytomegalovirus early promoter enhancer, the polyoma enhancer on the late side of the replication origin, and adenovirus enhancers.

For secretion of the translated polypeptide into the lumen of the endoplasmic reticulum, into the periplasmic space or into the extracellular environment, appropriate secretion signals may be incorporated into the expressed polypeptide. The signals may be endogenous to the polypeptide or they may be heterologous signals.

The polypeptide may be expressed in a modified form, such as a fusion protein, and may include not only secretion signals, but also additional heterologous functional regions. For instance, a region of additional amino acids, particularly charged amino acids, may be added to the N-terminus of the polypeptide to improve stability and persistence in the host cell, during purification, or during subsequent handling and storage. Also, peptide moieties may be added to the polypeptide to facilitate purification. Such regions may be removed prior to final preparation of the polypeptide. The addition of peptide moieties to polypeptides to engender secretion or excretion, to improve stability and to facilitate purification, among others, are familiar and routine techniques in the art. A preferred fusion protein comprises a heterologous region from immunoglobulin that is useful to solubilize proteins. For example, EP-A-O 464 533 (Canadian counterpart 2045869) discloses fusion proteins comprising various portions of constant region of immunoglobulin molecules together with another human protein or part thereof. In many cases, the Fc part in a fusion protein is thoroughly advantageous for use in therapy and diagnosis and thus results, for example, in improved pharmacokinetic properties (EP-A 0232 262).



On the other hand, for some uses it would be desirable to be able to delete the Fc part after the fusion protein has been expressed, detected and purified in the advantageous manner described. This is the case when Fc portion proves to be a hindrance to use in therapy and diagnosis, for example when the fusion protein is to be used as antigen for immunizations. In drug discovery, for example, human proteins, such as, hIL-5-receptor has been fused with Fc portions for the purpose of high-throughput screening assays to identify antagonists of hIL-5. See Bennett, D. *et al.*, *J. Molec. Recogn.* 8:52-58 (1995) and Johanson, K. *et al.*, *J. Biol. Chem.* 270 (16):9459-9471 (1995).

The *S. pneumoniae* polypeptides can be recovered and purified from recombinant cell cultures by well-known methods including ammonium sulfate or ethanol precipitation, acid extraction, anion or cation exchange chromatography, phosphocellulose chromatography, hydrophobic interaction chromatography, affinity chromatography, hydroxylapatite chromatography, lectin chromatography and high performance liquid chromatography ("HPLC") is employed for purification. Polypeptides of the present invention include naturally purified products, products of chemical synthetic procedures, and products produced by recombinant techniques from a prokaryotic or eukaryotic host, including, for example, bacterial, yeast, higher plant, insect and mammalian cells.

### ***Polypeptides and Fragments***

The invention further provides isolated polypeptides having the amino acid sequences described in Table 1, and shown as SEQ ID NO:2, SEQ ID NO:4, SEQ ID NO:6, and so on through SEQ ID NO:226, and peptides or polypeptides comprising portions of the above polypeptides. The terms "peptide" and "oligopeptide" are considered synonymous (as is commonly recognized) and each term can be used interchangeably as the context requires to indicate a chain of at least two amino acids coupled by peptidyl linkages. The word "polypeptide" is used herein for chains containing more than ten amino acid residues. All oligopeptide and polypeptide formulas or sequences herein are written from left to right and in the direction from amino terminus to carboxy terminus.

Some amino acid sequences of the *S. pneumoniae* polypeptides described in Table 1 can be varied without significantly effecting the antigenicity of the polypeptides. If such differences in sequence are contemplated, it should be remembered that there will be critical areas on the polypeptide which determine antigenicity. In general, it is possible to replace residues which do

not form part of an antigenic epitope without significantly effecting the antigenicity of a polypeptide. Guidance for such alterations is given in Table 2 wherein epitopes for each polypeptide is delineated.

5 The polypeptides of the present invention are preferably provided in an isolated form. By "isolated polypeptide" is intended a polypeptide removed from its native environment. Thus, a polypeptide produced and/or contained within a recombinant host cell is considered isolated for purposes of the present invention. Also intended as an "isolated polypeptide" is a polypeptide that has been purified, partially or substantially, from a recombinant host cell. For  
10 example, recombinantly produced versions of the *S. pneumoniae* polypeptides described in Table 1 can be substantially purified by the one-step method described by Smith and Johnson (*Gene* 67:31-40 (1988)).

The polypeptides of the present invention include: (a) an amino acid sequence of any of the polypeptides described in Table 1; and (b) an amino acid  
15 sequence of an epitope-bearing portion of any one of the polypeptides of (a); as well as polypeptides with at least 70% similarity, and more preferably at least 75%, 80%, 85%, 90%, 95%, 96%, 97%, 98%, or 99% similarity to those described in (a) or (b) above, as well as polypeptides having an amino acid sequence at least 70% identical, more preferably at least 75% identical, and still  
20 more preferably 80%, 85%, 90%, 95%, 96%, 97%, 98%, or 99% identical to those above.

By "% similarity" for two polypeptides is intended a similarity score produced by comparing the amino acid sequences of the two polypeptides using the Bestfit program (Wisconsin Sequence Analysis Package, Version 8 for  
25 Unix, Genetics Computer Group, University Research Park, 575 Science Drive, Madison, WI 53711) and the default settings for determining similarity. Bestfit uses the local homology algorithm of Smith and Waterman (*Advances in Applied Mathematics* 2:482-489 (1981)) to find the best segment of similarity between two sequences.

30 By a polypeptide having an amino acid sequence at least, for example, 95% "identical" to a reference amino acid sequence of a *S. pneumoniae* polypeptide is intended that the amino acid sequence of the polypeptide is identical to the reference sequence except that the polypeptide sequence may include up to five amino acid alterations per each 100 amino acids of the  
35 reference amino acid sequence. In other words, to obtain a polypeptide having an amino acid sequence at least 95% identical to a reference amino acid sequence, up to 5% of the amino acid residues in the reference sequence may be deleted or substituted with another amino acid, or a number of amino acids up to

5 5% of the total amino acid residues in the reference sequence may be inserted into the reference sequence. These alterations of the reference sequence may occur at the amino or carboxy terminal positions of the reference amino acid sequence or anywhere between those terminal positions, interspersed either individually among residues in the reference sequence or in one or more contiguous groups within the reference sequence.

10 The amino acid sequences shown in Table 1 may have on or more "X" residues. "X" represents unknown. Thus, for purposes of defining identity, if any amino acid is present at the same position in a reference amino acid sequence (shown in Table 1) where an X is shown, the two sequences are identical at that position.

15 As a practical matter, whether any particular polypeptide is at least 70%, 75%, 80%, 85%, 90%, 95%, 96%, 97%, 98%, or 99% identical to, for instance, an amino acid sequence shown in Table 1, can be determined conventionally using known computer programs such the Bestfit program (Wisconsin Sequence Analysis Package, Version 8 for Unix, Genetics Computer Group, University Research Park, 575 Science Drive, Madison, WI 53711). When using Bestfit or any other sequence alignment program to determine whether a particular sequence is, for instance, 95% identical to a reference sequence according to the present invention, the parameters are set, of course, such that the percentage of identity is calculated over the full length of the reference amino acid sequence and that gaps in homology of up to 5% of the total number of amino acid residues in the reference sequence are allowed.

25 As described below, the polypeptides of the present invention can also be used to raise polyclonal and monoclonal antibodies, which are useful in assays for detecting *Streptococcal* protein expression.

30 In another aspect, the invention provides peptides and polypeptides comprising epitope-bearing portions of the *S. pneumoniae* polypeptides of the invention. These epitopes are immunogenic or antigenic epitopes of the polypeptides of the invention. An "immunogenic epitope" is defined as a part of a protein that elicits an antibody response when the whole protein or polypeptide is the immunogen. These immunogenic epitopes are believed to be confined to a few loci on the molecule. On the other hand, a region of a protein molecule to which an antibody can bind is defined as an "antigenic determinant" or "antigenic epitope." The number of immunogenic epitopes of a protein generally is less than the number of antigenic epitopes (Geysen, *et al.*, *Proc. Natl. Acad. Sci. USA* 81:3998- 4002 (1983)). Predicted antigenic epitopes are shown in Table 2, below.

As to the selection of peptides or polypeptides bearing an antigenic epitope (*i.e.*, that contain a region of a protein molecule to which an antibody can bind), it is well known in that art that relatively short synthetic peptides that mimic part of a protein sequence are routinely capable of eliciting an antiserum that reacts with the partially mimicked protein (for instance, Sutcliffe, J., *et al.*, *Science* **219**:660-666 (1983)). Peptides capable of eliciting protein-reactive sera are frequently represented in the primary sequence of a protein, can be characterized by a set of simple chemical rules, and are confined neither to immunodominant regions of intact proteins (*i.e.*, immunogenic epitopes) nor to the amino or carboxyl terminals. Peptides that are extremely hydrophobic and those of six or fewer residues generally are ineffective at inducing antibodies that bind to the mimicked protein; longer, peptides, especially those containing proline residues, usually are effective (Sutcliffe, *et al.*, *supra*, p. 661). For instance, 18 of 20 peptides designed according to these guidelines, containing 8-39 residues covering 75% of the sequence of the influenza virus hemagglutinin HA1 polypeptide chain, induced antibodies that reacted with the HA1 protein or intact virus; and 12/12 peptides from the MuLV polymerase and 18/18 from the rabies glycoprotein induced antibodies that precipitated the respective proteins.

Antigenic epitope-bearing peptides and polypeptides of the invention are therefore useful to raise antibodies, including monoclonal antibodies, that bind specifically to a polypeptide of the invention. Thus, a high proportion of hybridomas obtained by fusion of spleen cells from donors immunized with an antigen epitope-bearing peptide generally secrete antibody reactive with the native protein (Sutcliffe, *et al.*, *supra*, p. 663). The antibodies raised by antigenic epitope-bearing peptides or polypeptides are useful to detect the mimicked protein, and antibodies to different peptides may be used for tracking the fate of various regions of a protein precursor which undergoes post-translational processing. The peptides and anti-peptide antibodies may be used in a variety of qualitative or quantitative assays for the mimicked protein, for instance in competition assays since it has been shown that even short peptides (*e.g.*, about 9 amino acids) can bind and displace the larger peptides in immunoprecipitation assays (for instance, Wilson, *et al.*, *Cell* **37**:767-778 (1984) p. 777). The anti-peptide antibodies of the invention also are useful for purification of the mimicked protein, for instance, by adsorption chromatography using methods well known in the art.

Antigenic epitope-bearing peptides and polypeptides of the invention designed according to the above guidelines preferably contain a sequence of at

least seven, more preferably at least nine and most preferably between about 15 to about 30 amino acids contained within the amino acid sequence of a polypeptide of the invention. However, peptides or polypeptides comprising a larger portion of an amino acid sequence of a polypeptide of the invention, containing about 30 to about 50 amino acids, or any length up to and including the entire amino acid sequence of a polypeptide of the invention, also are considered epitope-bearing peptides or polypeptides of the invention and also are useful for inducing antibodies that react with the mimicked protein. Preferably, the amino acid sequence of the epitope-bearing peptide is selected to provide substantial solubility in aqueous solvents (*i.e.*, the sequence includes relatively hydrophilic residues and highly hydrophobic sequences are preferably avoided); and sequences containing proline residues are particularly preferred.

Non-limiting examples of antigenic polypeptides or peptides that can be used to generate *Streptococcal*-specific antibodies include portions of the amino acid sequences identified in Table 1. More specifically, Table 2 discloses antigenic fragments of polypeptides of the present invention, which antigenic fragments comprise amino acid sequences from about the first amino acid residues indicated to about the last amino acid residue indicated for each fragment. The polypeptide fragments disclosed in Table 2 are believed to be antigenic regions of the *S. pneumoniae* polypeptides described in Table 1. Thus the invention further includes isolated peptides and polypeptides comprising an amino acid sequence of an epitope shown in Table 2 and polynucleotides encoding said polypeptides.

The epitope-bearing peptides and polypeptides of the invention may be produced by any conventional means for making peptides or polypeptides including recombinant means using nucleic acid molecules of the invention. For instance, an epitope-bearing amino acid sequence of the present invention may be fused to a larger polypeptide which acts as a carrier during recombinant production and purification, as well as during immunization to produce anti-peptide antibodies. Epitope-bearing peptides also may be synthesized using known methods of chemical synthesis. For instance, Houghten has described a simple method for synthesis of large numbers of peptides, such as 10-20 mg of 248 different 13 residue peptides representing single amino acid variants of a segment of the HA1 polypeptide which were prepared and characterized (by ELISA-type binding studies) in less than four weeks (Houghten, R. A. Proc. Natl. Acad. Sci. USA 82:5131-5135 (1985)). This "Simultaneous Multiple Peptide Synthesis (SMPS)" process is further described in U.S. Patent No. 4,631,211 to Houghten and coworkers (1986). In this procedure the individual

resins for the solid-phase synthesis of various peptides are contained in separate solvent-permeable packets, enabling the optimal use of the many identical repetitive steps involved in solid-phase methods. A completely manual procedure allows 500-1000 or more syntheses to be conducted simultaneously (Houghten, *et al.*, *supra*, p. 5134).

Epitope-bearing peptides and polypeptides of the invention are used to induce antibodies according to methods well known in the art (for instance, Sutcliffe, *et al.*, *supra*; Wilson, *et al.*, *supra*; Chow, M., *et al.*, *Proc. Natl. Acad. Sci. USA* **82**:910-914; and Bittle, F. J., *et al.*, *J. Gen. Virol.* **66**:2347-2354 (1985)). Generally, animals may be immunized with free peptide; however, anti-peptide antibody titer may be boosted by coupling of the peptide to a macromolecular carrier, such as keyhole limpet hemacyanin (KLH) or tetanus toxoid. For instance, peptides containing cysteine may be coupled to carrier using a linker such as m-maleimidobenzoyl-N-hydroxysuccinimide ester (MBS), while other peptides may be coupled to carrier using a more general linking agent such as glutaraldehyde. Animals such as rabbits, rats and mice are immunized with either free or carrier-coupled peptides, for instance, by intraperitoneal and/or intradermal injection of emulsions containing about 100  $\mu$ g peptide or carrier protein and Freund's adjuvant. Several booster injections may be needed, for instance, at intervals of about two weeks, to provide a useful titer of anti-peptide antibody which can be detected, for example, by ELISA assay using free peptide adsorbed to a solid surface. The titer of anti-peptide antibodies in serum from an immunized animal may be increased by selection of anti-peptide antibodies, for instance, by adsorption to the peptide on a solid support and elution of the selected antibodies according to methods well known in the art.

Immunogenic epitope-bearing peptides of the invention, *i.e.*, those parts of a protein that elicit an antibody response when the whole protein is the immunogen, are identified according to methods known in the art. For instance, Geysen, *et al.*, *supra*, discloses a procedure for rapid concurrent synthesis on solid supports of hundreds of peptides of sufficient purity to react in an enzyme-linked immunosorbent assay. Interaction of synthesized peptides with antibodies is then easily detected without removing them from the support. In this manner a peptide bearing an immunogenic epitope of a desired protein may be identified routinely by one of ordinary skill in the art. For instance, the immunologically important epitope in the coat protein of foot-and-mouth disease virus was located by Geysen *et al.* *supra* with a resolution of seven amino acids by synthesis of an overlapping set of all 208 possible hexapeptides covering the

entire 213 amino acid sequence of the protein. Then, a complete replacement set of peptides in which all 20 amino acids were substituted in turn at every position within the epitope were synthesized, and the particular amino acids conferring specificity for the reaction with antibody were determined. Thus, peptide analogs of the epitope-bearing peptides of the invention can be made routinely by this method. U.S. Patent No. 4,708,781 to Geysen (1987) further describes this method of identifying a peptide bearing an immunogenic epitope of a desired protein.

Further still, U.S. Patent No. 5,194,392, to Geysen (1990), describes a general method of detecting or determining the sequence of monomers (amino acids or other compounds) which is a topological equivalent of the epitope (*i.e.*, a "mimotope") which is complementary to a particular paratope (antigen binding site) of an antibody of interest. More generally, U.S. Patent No. 4,433,092, also to Geysen (1989), describes a method of detecting or determining a sequence of monomers which is a topographical equivalent of a ligand which is complementary to the ligand binding site of a particular receptor of interest. Similarly, U.S. Patent No. 5,480,971 to Houghten, R. A. *et al.* (1996) discloses linear C<sub>1</sub>-C<sub>7</sub>-alkyl peralkylated oligopeptides and sets and libraries of such peptides, as well as methods for using such oligopeptide sets and libraries for determining the sequence of a peralkylated oligopeptide that preferentially binds to an acceptor molecule of interest. Thus, non-peptide analogs of the epitope-bearing peptides of the invention also can be made routinely by these methods.

The entire disclosure of each document cited in this section on "Polypeptides and Fragments" is hereby incorporated herein by reference.

As one of skill in the art will appreciate, the polypeptides of the present invention and the epitope-bearing fragments thereof described above can be combined with parts of the constant domain of immunoglobulins (IgG), resulting in chimeric polypeptides. These fusion proteins facilitate purification and show an increased half-life *in vivo*. This has been shown, *e.g.*, for chimeric proteins consisting of the first two domains of the human CD4-polypeptide and various domains of the constant regions of the heavy or light chains of mammalian immunoglobulins (EPA 0,394,827; Traunecker *et al.*, *Nature* 331:84-86 (1988)). Fusion proteins that have a disulfide-linked dimeric structure due to the IgG part can also be more efficient in binding and neutralizing other molecules than a monomeric *S. pneumoniae* polypeptide or fragment thereof alone (Fountoulakis *et al.*, *J. Biochem.* 270:3958-3964 (1995)).

### Diagnostic Assays

The present invention further relates to a method for assaying for *Streptococcal* infection in an animal *via* detecting the expression of genes encoding *Streptococcal* polypeptides (*e.g.*, the polypeptides described Table 1). This method comprises analyzing tissue or body fluid from the animal for *Streptococcus*-specific antibodies or *Streptococcal* nucleic acids or proteins. Analysis of nucleic acid specific to *Streptococcus* can be done by PCR or hybridization techniques using nucleic acid sequences of the present invention as either hybridization probes or primers (*cf. Molecular Cloning: A Laboratory Manual, second edition*, edited by Sambrook, Fritsch, & Maniatis, Cold Spring Harbor Laboratory, 1989; Ereemeeva *et al.*, *J. Clin. Microbiol.* 32:803-810 (1994) which describes differentiation among spotted fever group *Rickettsiae* species by analysis of restriction fragment length polymorphism of PCR-amplified DNA). Methods for detecting *B. burgdorferi* nucleic acids *via* PCR are described, for example, in Chen *et al.*, *J. Clin. Microbiol.* 32:589-595 (1994).

Where diagnosis of a disease state related to infection with *Streptococcus* has already been made, the present invention is useful for monitoring progression or regression of the disease state whereby patients exhibiting enhanced *Streptococcus* gene expression will experience a worse clinical outcome relative to patients expressing these gene(s) at a lower level.

By "assaying for *Streptococcal* infection in an animal *via* detection of genes encoding *Streptococcal* polypeptides" is intended qualitatively or quantitatively measuring or estimating the level of one or more *Streptococcus* polypeptides or the level of nucleic acid encoding *Streptococcus* polypeptides in a first biological sample either directly (*e.g.*, by determining or estimating absolute protein level or nucleic level) or relatively (*e.g.*, by comparing to the *Streptococcus* polypeptide level or mRNA level in a second biological sample). The *Streptococcus* polypeptide level or nucleic acid level in the second sample used for a relative comparison may be undetectable if obtained from an animal which is not infected with *Streptococcus*. When monitoring the progression or regression of a disease state, the *Streptococcus* polypeptide level or nucleic acid level may be compared to a second sample obtained from either an animal infected with *Streptococcus* or the same animal from which the first sample was obtained but taken from that animal at a different time than the first. As will be appreciated in the art, once a standard *Streptococcus* polypeptide level or nucleic

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acid level which corresponds to a particular stage of a *Streptococcus* infection is known, it can be used repeatedly as a standard for comparison.

By "biological sample" is intended any biological sample obtained from an animal, cell line, tissue culture, or other source which contains *Streptococcus* polypeptide, mRNA, or DNA. Biological samples include body fluids (such as plasma and synovial fluid) which contain *Streptococcus* polypeptides, and muscle, skin, and cartilage tissues. Methods for obtaining tissue biopsies and body fluids are well known in the art.

The present invention is useful for detecting diseases related to *Streptococcus* infections in animals. Preferred animals include monkeys, apes, cats, dogs, cows, pigs, mice, horses, rabbits and humans. Particularly preferred are humans.

Total RNA can be isolated from a biological sample using any suitable technique such as the single-step guanidinium-thiocyanate-phenol-chloroform method described in Chomczynski and Sacchi, *Anal. Biochem.* 162:156-159 (1987). mRNA encoding *Streptococcus* polypeptides having sufficient homology to the nucleic acid sequences identified in Table 1 to allow for hybridization between complementary sequences are then assayed using any appropriate method. These include Northern blot analysis, S1 nuclease mapping, the polymerase chain reaction (PCR), reverse transcription in combination with the polymerase chain reaction (RT-PCR), and reverse transcription in combination with the ligase chain reaction (RT-LCR).

Northern blot analysis can be performed as described in Harada *et al.*, *Cell* 63:303-312 (1990). Briefly, total RNA is prepared from a biological sample as described above. For the Northern blot, the RNA is denatured in an appropriate buffer (such as glyoxal/dimethyl sulfoxide/sodium phosphate buffer), subjected to agarose gel electrophoresis, and transferred onto a nitrocellulose filter. After the RNAs have been linked to the filter by a UV linker, the filter is prehybridized in a solution containing formamide, SSC, Denhardt's solution, denatured salmon sperm, SDS, and sodium phosphate buffer. A *S. pneumoniae* polypeptide DNA sequence shown in Table 1 labeled according to any appropriate method (such as the <sup>32</sup>P-multiprimed DNA labeling system (Amersham)) is used as probe. After hybridization overnight, the filter is washed and exposed to x-ray film. DNA for use as probe according to the present invention is described in the sections above and will preferably at least 15 bp in length.

S1 mapping can be performed as described in Fujita *et al.*, *Cell* 49:357-367 (1987). To prepare probe DNA for use in S1 mapping, the sense

strand of an above-described *S. pneumoniae* DNA sequence of the present invention is used as a template to synthesize labeled antisense DNA. The antisense DNA can then be digested using an appropriate restriction endonuclease to generate further DNA probes of a desired length. Such antisense probes are useful for visualizing protected bands corresponding to the target mRNA (i.e., mRNA encoding *Streptococcus* polypeptides).

Preferably, levels of mRNA encoding *Streptococcus* polypeptides are assayed using the RT-PCR method described in Makino *et al.*, *Technique* 2:295-301 (1990). By this method, the radioactivities of the "amplicons" in the polyacrylamide gel bands are linearly related to the initial concentration of the target mRNA. Briefly, this method involves adding total RNA isolated from a biological sample in a reaction mixture containing a RT primer and appropriate buffer. After incubating for primer annealing, the mixture can be supplemented with a RT buffer, dNTPs, DTT, RNase inhibitor and reverse transcriptase. After incubation to achieve reverse transcription of the RNA, the RT products are then subject to PCR using labeled primers. Alternatively, rather than labeling the primers, a labeled dNTP can be included in the PCR reaction mixture. PCR amplification can be performed in a DNA thermal cycler according to conventional techniques. After a suitable number of rounds to achieve amplification, the PCR reaction mixture is electrophoresed on a polyacrylamide gel. After drying the gel, the radioactivity of the appropriate bands (corresponding to the mRNA encoding the *Streptococcus* polypeptides)) is quantified using an imaging analyzer. RT and PCR reaction ingredients and conditions, reagent and gel concentrations, and labeling methods are well known in the art. Variations on the RT-PCR method will be apparent to the skilled artisan.

Assaying *Streptococcus* polypeptide levels in a biological sample can occur using any art-known method. Preferred for assaying *Streptococcus* polypeptide levels in a biological sample are antibody-based techniques. For example, *Streptococcus* polypeptide expression in tissues can be studied with classical immunohistological methods. In these, the specific recognition is provided by the primary antibody (polyclonal or monoclonal) but the secondary detection system can utilize fluorescent, enzyme, or other conjugated secondary antibodies. As a result, an immunohistological staining of tissue section for pathological examination is obtained. Tissues can also be extracted, e.g., with urea and neutral detergent, for the liberation of *Streptococcus* polypeptides for Western-blot or dot/slot assay (Jalkanen, M., *et al.*, *J. Cell. Biol.* 101:976-985 (1985); Jalkanen, M., *et al.*, *J. Cell. Biol.* 105:3087-3096 (1987)). In this

technique, which is based on the use of cationic solid phases, quantitation of a *Streptococcus* polypeptide can be accomplished using an isolated *Streptococcus* polypeptide as a standard. This technique can also be applied to body fluids.

Other antibody-based methods useful for detecting *Streptococcus* polypeptide gene expression include immunoassays, such as the enzyme linked immunosorbent assay (ELISA) and the radioimmunoassay (RIA). For example, a *Streptococcus* polypeptide-specific monoclonal antibodies can be used both as an immunoabsorbent and as an enzyme-labeled probe to detect and quantify a *Streptococcus* polypeptide. The amount of a *Streptococcus* polypeptide present in the sample can be calculated by reference to the amount present in a standard preparation using a linear regression computer algorithm. Such an ELISA for detecting a tumor antigen is described in Iacobelli *et al.*, *Breast Cancer Research and Treatment* 11:19-30 (1988). In another ELISA assay, two distinct specific monoclonal antibodies can be used to detect *Streptococcus* polypeptides in a body fluid. In this assay, one of the antibodies is used as the immunoabsorbent and the other as the enzyme-labeled probe.

The above techniques may be conducted essentially as a "one-step" or "two-step" assay. The "one-step" assay involves contacting the *Streptococcus* polypeptide with immobilized antibody and, without washing, contacting the mixture with the labeled antibody. The "two-step" assay involves washing before contacting the mixture with the labeled antibody. Other conventional methods may also be employed as suitable. It is usually desirable to immobilize one component of the assay system on a support, thereby allowing other components of the system to be brought into contact with the component and readily removed from the sample.

*Streptococcus* polypeptide-specific antibodies for use in the present invention can be raised against an intact *S. pneumoize* polypeptide of the present invention or fragment thereof. These polypeptides and fragments may be administered to an animal (*e.g.*, rabbit or mouse) either with a carrier protein (*e.g.*, albumin) or, if long enough (*e.g.*, at least about 25 amino acids), without a carrier.

As used herein, the term "antibody" (Ab) or "monoclonal antibody" (Mab) is meant to include intact molecules as well as antibody fragments (such as, for example, Fab and F(ab')<sub>2</sub> fragments) which are capable of specifically binding to a *Streptococcus* polypeptide. Fab and F(ab')<sub>2</sub> fragments lack the Fc fragment of intact antibody, clear more rapidly from the circulation, and may have less non-specific tissue binding of an intact antibody (Wahl *et al.*, *J. Nucl. Med.* 24:316-325 (1983)). Thus, these fragments are preferred.

The antibodies of the present invention may be prepared by any of a variety of methods. For example, the *S. pneumoniae* polypeptides identified in Table 1, or fragments thereof, can be administered to an animal in order to induce the production of sera containing polyclonal antibodies. In a preferred method, a preparation of a *S. pneumoniae* polypeptide of the present invention is prepared and purified to render it substantially free of natural contaminants. Such a preparation is then introduced into an animal in order to produce polyclonal antisera of high specific activity.

In the most preferred method, the antibodies of the present invention are monoclonal antibodies. Such monoclonal antibodies can be prepared using hybridoma technology (Kohler *et al.*, *Nature* 256:495 (1975); Kohler *et al.*, *Eur. J. Immunol.* 6:511 (1976); Kohler *et al.*, *Eur. J. Immunol.* 6:292 (1976); Hammerling *et al.*, In: *Monoclonal Antibodies and T-Cell Hybridomas*, Elsevier, N.Y., (1981) pp. 563-681 ). In general, such procedures involve immunizing an animal (preferably a mouse) with a *S. pneumoniae* polypeptide antigen of the present invention. Suitable cells can be recognized by their capacity to bind anti-*Streptococcus* polypeptide antibody. Such cells may be cultured in any suitable tissue culture medium; however, it is preferable to culture cells in Earle's modified Eagle's medium supplemented with 10% fetal bovine serum (inactivated at about 56°C), and supplemented with about 10 g/l of nonessential amino acids, about 1,000 U/ml of penicillin, and about 100 µg/ml of streptomycin. The splenocytes of such mice are extracted and fused with a suitable myeloma cell line. Any suitable myeloma cell line may be employed in accordance with the present invention; however, it is preferable to employ the parent myeloma cell line (SP<sub>2</sub>O), available from the American Type Culture Collection, Rockville, Maryland. After fusion, the resulting hybridoma cells are selectively maintained in HAT medium, and then cloned by limiting dilution as described by Wands *et al.* (*Gastroenterology* 80:225-232 (1981)). The hybridoma cells obtained through such a selection are then assayed to identify clones which secrete antibodies capable of binding the *Streptococcus* polypeptide antigen administered to immunized animal.

Alternatively, additional antibodies capable of binding to *Streptococcus* polypeptide antigens may be produced in a two-step procedure through the use of anti-idiotypic antibodies. Such a method makes use of the fact that antibodies are themselves antigens, and that, therefore, it is possible to obtain an antibody which binds to a second antibody. In accordance with this method, *Streptococcus* polypeptide-specific antibodies are used to immunize an animal, preferably a mouse. The splenocytes of such an animal are then used to

produce hybridoma cells, and the hybridoma cells are screened to identify clones which produce an antibody whose ability to bind to the *Streptococcus* polypeptide-specific antibody can be blocked by a *Streptococcus* polypeptide antigen. Such antibodies comprise anti-idiotypic antibodies to the *Streptococcus* polypeptide-specific antibody and can be used to immunize an animal to induce formation of further *Streptococcus* polypeptide-specific antibodies.

It will be appreciated that Fab and F(ab')<sub>2</sub> and other fragments of the antibodies of the present invention may be used according to the methods disclosed herein. Such fragments are typically produced by proteolytic cleavage, using enzymes such as papain (to produce Fab fragments) or pepsin (to produce F(ab')<sub>2</sub> fragments). Alternatively, *Streptococcus* polypeptide-binding fragments can be produced through the application of recombinant DNA technology or through synthetic chemistry.

Of special interest to the present invention are antibodies to *Streptococcus* polypeptide antigens which are produced in humans, or are "humanized" (i.e., non-immunogenic in a human) by recombinant or other technology. Humanized antibodies may be produced, for example by replacing an immunogenic portion of an antibody with a corresponding, but non-immunogenic portion (i.e., chimeric antibodies) (Robinson, R.R. *et al.*, International Patent Publication PCT/US86/02269; Akira, K. *et al.*, European Patent Application 184,187; Taniguchi, M., European Patent Application 171,496; Morrison, S.L. *et al.*, European Patent Application 173,494; Neuberger, M.S. *et al.*, PCT Application WO 86/01533; Cabilly, S. *et al.*, European Patent Application 125,023; Better, M. *et al.*, *Science* 240:1041-1043 (1988); Liu, A.Y. *et al.*, *Proc. Natl. Acad. Sci. USA* 84:3439-3443 (1987); Liu, A.Y. *et al.*, *J. Immunol.* 139:3521-3526 (1987); Sun, L.K. *et al.*, *Proc. Natl. Acad. Sci. USA* 84:214-218 (1987); Nishimura, Y. *et al.*, *Canc. Res.* 47:999-1005 (1987); Wood, C.R. *et al.*, *Nature* 314:446-449 (1985); Shaw *et al.*, *J. Natl. Cancer Inst.* 80:1553-1559 (1988). General reviews of "humanized" chimeric antibodies are provided by Morrison, S.L. (*Science*, 229:1202-1207 (1985)) and by Oi, V.T. *et al.*, *BioTechniques* 4:214 (1986)). Suitable "humanized" antibodies can be alternatively produced by CDR or CEA substitution (Jones, P.T. *et al.*, *Nature* 321:552-525 (1986); Verhoeyan *et al.*, *Science* 239:1534 (1988); Beidler, C.B. *et al.*, *J. Immunol.* 141:4053-4060 (1988)).

Suitable enzyme labels include, for example, those from the oxidase group, which catalyze the production of hydrogen peroxide by reacting with substrate. Glucose oxidase is particularly preferred as it has good stability and

its substrate (glucose) is readily available. Activity of an oxidase label may be assayed by measuring the concentration of hydrogen peroxide formed by the enzyme-labeled antibody/substrate reaction. Besides enzymes, other suitable labels include radioisotopes, such as iodine ( $^{125}\text{I}$ ,  $^{121}\text{I}$ ), carbon ( $^{14}\text{C}$ ), sulphur ( $^{35}\text{S}$ ), tritium ( $^3\text{H}$ ), indium ( $^{112}\text{In}$ ), and technetium ( $^{99\text{m}}\text{Tc}$ ), and fluorescent labels, such as fluorescein and rhodamine, and biotin.

Further suitable labels for the *Streptococcus* polypeptide-specific antibodies of the present invention are provided below. Examples of suitable enzyme labels include malate dehydrogenase, staphylococcal nuclease, delta-5-steroid isomerase, yeast-alcohol dehydrogenase, alpha-glycerol phosphate dehydrogenase, triose phosphate isomerase, peroxidase, alkaline phosphatase, asparaginase, glucose oxidase, beta-galactosidase, ribonuclease, urease, catalase, glucose-6-phosphate dehydrogenase, glucoamylase, and acetylcholine esterase.

Examples of suitable radioisotopic labels include  $^3\text{H}$ ,  $^{111}\text{In}$ ,  $^{125}\text{I}$ ,  $^{131}\text{I}$ ,  $^{32}\text{P}$ ,  $^{35}\text{S}$ ,  $^{14}\text{C}$ ,  $^{51}\text{Cr}$ ,  $^{57}\text{Co}$ ,  $^{58}\text{Co}$ ,  $^{59}\text{Fe}$ ,  $^{75}\text{Se}$ ,  $^{152}\text{Eu}$ ,  $^{90}\text{Y}$ ,  $^{67}\text{Cu}$ ,  $^{217}\text{Bi}$ ,  $^{211}\text{At}$ ,  $^{212}\text{Pb}$ ,  $^{47}\text{Sc}$ ,  $^{109}\text{Pd}$ , etc.  $^{111}\text{In}$  is a preferred isotope where *in vivo* imaging is used since it avoids the problem of dehalogenation of the  $^{125}\text{I}$  or  $^{131}\text{I}$ -labeled monoclonal antibody by the liver. In addition, this radionuclide has a more favorable gamma emission energy for imaging (Perkins *et al.*, *Eur. J. Nucl. Med.* 10:296-301 (1985); Carasquillo *et al.*, *J. Nucl. Med.* 28:281-287 (1987)). For example,  $^{111}\text{In}$  coupled to monoclonal antibodies with 1-(P-isothiocyanatobenzyl)-DPTA has shown little uptake in non-tumorous tissues, particularly the liver, and therefore enhances specificity of tumor localization (Esteban *et al.*, *J. Nucl. Med.* 28:861-870 (1987)).

Examples of suitable non-radioactive isotopic labels include  $^{157}\text{Gd}$ ,  $^{55}\text{Mn}$ ,  $^{162}\text{Dy}$ ,  $^{52}\text{Tr}$ , and  $^{56}\text{Fe}$ .

Examples of suitable fluorescent labels include an  $^{152}\text{Eu}$  label, a fluorescein label, an isothiocyanate label, a rhodamine label, a phycoerythrin label, a phycocyanin label, an allophycocyanin label, an o-phthalaldehyde label, and a fluorecamine label.

Examples of suitable toxin labels include diphtheria toxin, ricin, and cholera toxin.

Examples of chemiluminescent labels include a luminal label, an isoluminal label, an aromatic acridinium ester label, an imidazole label, an acridinium salt label, an oxalate ester label, a luciferin label, a luciferase label, and an aequorin label.

Examples of nuclear magnetic resonance contrasting agents include heavy metal nuclei such as Gd, Mn, and iron.

Typical techniques for binding the above-described labels to antibodies are provided by Kennedy *et al.*, *Clin. Chim. Acta* 70:1-31 (1976), and Schurs *et al.*, *Clin. Chim. Acta* 81:1-40 (1977). Coupling techniques mentioned in the latter are the glutaraldehyde method, the periodate method, the dimaleimide method, the m-maleimidobenzyl-N-hydroxy-succinimide ester method, all of which methods are incorporated by reference herein.

In a related aspect, the invention includes a diagnostic kit for use in screening serum containing antibodies specific against *S. pneumoniae* infection. Such a kit may include an isolated *S. pneumoniae* antigen comprising an epitope which is specifically immunoreactive with at least one anti-*S. pneumoniae* antibody. Such a kit also includes means for detecting the binding of said antibody to the antigen. In specific embodiments, the kit may include a recombinantly produced or chemically synthesized peptide or polypeptide antigen. The peptide or polypeptide antigen may be attached to a solid support.

In a more specific embodiment, the detecting means of the above-described kit includes a solid support to which said peptide or polypeptide antigen is attached. Such a kit may also include a non-attached reporter-labelled anti-human antibody. In this embodiment, binding of the antibody to the *S. pneumoniae* antigen can be detected by binding of the reporter labelled antibody to the anti-*S. pneumoniae* antibody.

In a related aspect, the invention includes a method of detecting *S. pneumoniae* infection in a subject. This detection method includes reacting a body fluid, preferably serum, from the subject with an isolated *S. pneumoniae* antigen, and examining the antigen for the presence of bound antibody. In a specific embodiment, the method includes a polypeptide antigen attached to a solid support, and serum is reacted with the support. Subsequently, the support is reacted with a reporter-labelled anti-human antibody. The support is then examined for the presence of reporter-labelled antibody.

The solid surface reagent employed in the above assays and kits is prepared by known techniques for attaching protein material to solid support material, such as polymeric beads, dip sticks, 96-well plates or filter material. These attachment methods generally include non-specific adsorption of the protein to the support or covalent attachment of the protein, typically through a free amine group, to a chemically reactive group on the solid support, such as an activated carboxyl, hydroxyl, or aldehyde group. Alternatively, streptavidin coated plates can be used in conjunction with biotinylated antigen(s).

### *Therapeutics and Modes of Administration*

The present invention also provides vaccines comprising one or more polypeptides of the present invention. Heterogeneity in the composition of a vaccine may be provided by combining *S. pneumoniae* polypeptides of the present invention. Multi-component vaccines of this type are desirable because they are likely to be more effective in eliciting protective immune responses against multiple species and strains of the *Streptococcus* genus than single polypeptide vaccines. Thus, as discussed in detail below, a multi-component vaccine of the present invention may contain one or more, preferably 2 to about 20, more preferably 2 to about 15, and most preferably 3 to about 8, of the *S. pneumoniae* polypeptides identified in Table 1, or fragments thereof.

Multi-component vaccines are known in the art to elicit antibody production to numerous immunogenic components. Decker, M. and Edwards, K., *J. Infect. Dis.* 174:S270-275 (1996). In addition, a hepatitis B, diphtheria, tetanus, pertussis tetravalent vaccine has recently been demonstrated to elicit protective levels of antibodies in human infants against all four pathogenic agents. Aristegui, J. *et al.*, *Vaccine* 15:7-9 (1997).

The present invention thus also includes multi-component vaccines. These vaccines comprise more than one polypeptide, immunogen or antigen. An example of such a multi-component vaccine would be a vaccine comprising more than one of the *S. pneumoniae* polypeptides described in Table 1. A second example is a vaccine comprising one or more, for example 2 to 10, of the *S. pneumoniae* polypeptides identified in Table 1 and one or more, for example 2 to 10, additional polypeptides of either streptococcal or non-streptococcal origin. Thus, a multi-component vaccine which confers protective immunity to both a Streptococcal infection and infection by another pathogenic agent is also within the scope of the invention.

As indicated above, the vaccines of the present invention are expected to elicit a protective immune response against infections caused by species and strains of *Streptococcus* other than strain of *S. pneumoniae* deposited with that ATCC.

Further within the scope of the invention are whole cell and whole viral vaccines. Such vaccines may be produced recombinantly and involve the expression of one or more of the *S. pneumoniae* polypeptides described in Table 1. For example, the *S. pneumoniae* polypeptides of the present invention may be either secreted or localized intracellular, on the cell surface, or in the periplasmic space. Further, when a recombinant virus is used, the *S.*



*pneumoniae* polypeptides of the present invention may, for example, be localized in the viral envelope, on the surface of the capsid, or internally within the capsid. Whole cells vaccines which employ cells expressing heterologous proteins are known in the art. See, e.g., Robinson, K. *et al.*, *Nature Biotech.* 15:653-657 (1997); Sirard, J. *et al.*, *Infect. Immun.* 65:2029-2033 (1997); Chabalgoity, J. *et al.*, *Infect. Immun.* 65:2402-2412 (1997). These cells may be administered live or may be killed prior to administration. Chabalgoity, J. *et al.*, *supra*, for example, report the successful use in mice of a live attenuated *Salmonella* vaccine strain which expresses a portion of a platyhelminth fatty acid-binding protein as a fusion protein on its cells surface.

A multi-component vaccine can also be prepared using techniques known in the art by combining one or more *S. pneumoniae* polypeptides of the present invention, or fragments thereof, with additional non-streptococcal components (e.g., diphtheria toxin or tetanus toxin, and/or other compounds known to elicit an immune response). Such vaccines are useful for eliciting protective immune responses to both members of the *Streptococcus* genus and non-streptococcal pathogenic agents.

The vaccines of the present invention also include DNA vaccines. DNA vaccines are currently being developed for a number of infectious diseases. Boyer, J *et al.*, *Nat. Med.* 3:526-532 (1997); reviewed in Spier, R., *Vaccine* 14:1285-1288 (1996). Such DNA vaccines contain a nucleotide sequence encoding one or more *S. pneumoniae* polypeptides of the present invention oriented in a manner that allows for expression of the subject polypeptide. The direct administration of plasmid DNA encoding *B. burgdorgeri* OspA has been shown to elicit protective immunity in mice against borrelial challenge. Luke, C. *et al.*, *J. Infect. Dis.* 175:91-97 (1997).

The present invention also relates to the administration of a vaccine which is co-administered with a molecule capable of modulating immune responses. Kim, J. *et al.*, *Nature Biotech.* 15:641-646 (1997), for example, report the enhancement of immune responses produced by DNA immunizations when DNA sequences encoding molecules which stimulate the immune response are co-administered. In a similar fashion, the vaccines of the present invention may be co-administered with either nucleic acids encoding immune modulators or the immune modulators themselves. These immune modulators include granulocyte macrophage colony stimulating factor (GM-CSF) and CD86.

The vaccines of the present invention may be used to confer resistance to streptococcal infection by either passive or active immunization. When the

vaccines of the present invention are used to confer resistance to streptococcal infection through active immunization, a vaccine of the present invention is administered to an animal to elicit a protective immune response which either prevents or attenuates a streptococcal infection. When the vaccines of the present invention are used to confer resistance to streptococcal infection through passive immunization, the vaccine is provided to a host animal (e.g., human, dog, or mouse), and the antisera elicited by this antisera is recovered and directly provided to a recipient suspected of having an infection caused by a member of the *Streptococcus* genus.

The ability to label antibodies, or fragments of antibodies, with toxin molecules provides an additional method for treating streptococcal infections when passive immunization is conducted. In this embodiment, antibodies, or fragments of antibodies, capable of recognizing the *S. pneumoniae* polypeptides disclosed herein, or fragments thereof, as well as other *Streptococcus* proteins, are labeled with toxin molecules prior to their administration to the patient. When such toxin derivatized antibodies bind to *Streptococcus* cells, toxin moieties will be localized to these cells and will cause their death.

The present invention thus concerns and provides a means for preventing or attenuating a streptococcal infection resulting from organisms which have antigens that are recognized and bound by antisera produced in response to the polypeptides of the present invention. As used herein, a vaccine is said to prevent or attenuate a disease if its administration to an animal results either in the total or partial attenuation (i.e., suppression) of a symptom or condition of the disease, or in the total or partial immunity of the animal to the disease.

The administration of the vaccine (or the antisera which it elicits) may be for either a "prophylactic" or "therapeutic" purpose. When provided prophylactically, the compound(s) are provided in advance of any symptoms of streptococcal infection. The prophylactic administration of the compound(s) serves to prevent or attenuate any subsequent infection. When provided therapeutically, the compound(s) is provided upon or after the detection of symptoms which indicate that an animal may be infected with a member of the *Streptococcus* genus. The therapeutic administration of the compound(s) serves to attenuate any actual infection. Thus, the *S. pneumoniae* polypeptides, and fragments thereof, of the present invention may be provided either prior to the onset of infection (so as to prevent or attenuate an anticipated infection) or after the initiation of an actual infection.

5 The polypeptides of the invention, whether encoding a portion of a native protein or a functional derivative thereof, may be administered in pure form or may be coupled to a macromolecular carrier. Example of such carriers are proteins and carbohydrates. Suitable proteins which may act as  
10 macromolecular carrier for enhancing the immunogenicity of the polypeptides of the present invention include keyhole limpet hemacyanin (KLH) tetanus toxoid, pertussis toxin, bovine serum albumin, and ovalbumin. Methods for coupling the polypeptides of the present invention to such macromolecular carriers are disclosed in Harlow *et al.*, *Antibodies: A Laboratory Manual, 2nd Ed.*; Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York (1988), the entire disclosure of which is incorporated by reference herein.

15 A composition is said to be "pharmacologically acceptable" if its administration can be tolerated by a recipient animal and is otherwise suitable for administration to that animal. Such an agent is said to be administered in a "therapeutically effective amount" if the amount administered is physiologically significant. An agent is physiologically significant if its presence results in a detectable change in the physiology of a recipient patient.

20 While in all instances the vaccine of the present invention is administered as a pharmacologically acceptable compound, one skilled in the art would recognize that the composition of a pharmacologically acceptable compound varies with the animal to which it is administered. For example, a vaccine intended for human use will generally not be co-administered with Freund's adjuvant. Further, the level of purity of the *S. pneumoniae* polypeptides of the present invention will normally be higher when administered to a human than  
25 when administered to a non-human animal.

30 As would be understood by one of ordinary skill in the art, when the vaccine of the present invention is provided to an animal, it may be in a composition which may contain salts, buffers, adjuvants, or other substances which are desirable for improving the efficacy of the composition. Adjuvants are substances that can be used to specifically augment a specific immune response. These substances generally perform two functions: (1) they protect the antigen(s) from being rapidly catabolized after administration and (2) they nonspecifically stimulate immune responses.

35 Normally, the adjuvant and the composition are mixed prior to presentation to the immune system, or presented separately, but into the same site of the animal being immunized. Adjuvants can be loosely divided into several groups based upon their composition. These groups include oil adjuvants (for example, Freund's complete and incomplete), mineral salts (for

example,  $\text{AlK}(\text{SO}_4)_2$ ,  $\text{AlNa}(\text{SO}_4)_2$ ,  $\text{AlNH}_4(\text{SO}_4)$ , silica, kaolin, and carbon), polynucleotides (for example, poly IC and poly AU acids), and certain natural substances (for example, wax D from *Mycobacterium tuberculosis*, as well as substances found in *Corynebacterium parvum*, or *Bordetella pertussis*, and members of the genus *Brucella*. Other substances useful as adjuvants are the saponins such as, for example, Quil A. (Superfos A/S, Denmark). Preferred adjuvants for use in the present invention include aluminum salts, such as  $\text{AlK}(\text{SO}_4)_2$ ,  $\text{AlNa}(\text{SO}_4)_2$ , and  $\text{AlNH}_4(\text{SO}_4)$ . Examples of materials suitable for use in vaccine compositions are provided in *Remington's Pharmaceutical Sciences* (Osol, A, Ed, Mack Publishing Co, Easton, PA, pp. 1324-1341 (1980), which reference is incorporated herein by reference).

The therapeutic compositions of the present invention can be administered parenterally by injection, rapid infusion, nasopharyngeal absorption (intranasopharyngeally), dermoabsorption, or orally. The compositions may alternatively be administered intramuscularly, or intravenously. Compositions for parenteral administration include sterile aqueous or non-aqueous solutions, suspensions, and emulsions. Examples of non-aqueous solvents are propylene glycol, polyethylene glycol, vegetable oils such as olive oil, and injectable organic esters such as ethyl oleate. Carriers or occlusive dressings can be used to increase skin permeability and enhance antigen absorption. Liquid dosage forms for oral administration may generally comprise a liposome solution containing the liquid dosage form. Suitable forms for suspending liposomes include emulsions, suspensions, solutions, syrups, and elixirs containing inert diluents commonly used in the art, such as purified water. Besides the inert diluents, such compositions can also include adjuvants, wetting agents, emulsifying and suspending agents, or sweetening, flavoring, or perfuming agents.

Therapeutic compositions of the present invention can also be administered in encapsulated form. For example, intranasal immunization of mice against *Bordetella pertussis* infection using vaccines encapsulated in biodegradable microsphere composed of poly(DL-lactide-co-glycolide) has been shown to stimulate protective immune responses. Shahin, R. *et al.*, *Infect. Immun.* 63:1195-1200 (1995). Similarly, orally administered encapsulated *Salmonella typhimurium* antigens have also been shown to elicit protective immunity in mice. Allaoui-Attarki, K. *et al.*, *Infect. Immun.* 65:853-857 (1997). Encapsulated vaccines of the present invention can be administered by

a variety of routes including those involving contacting the vaccine with mucous membranes (e.g., intranasally, intracolonicly, intraduodenally).

Many different techniques exist for the timing of the immunizations when a multiple administration regimen is utilized. It is possible to use the compositions of the invention more than once to increase the levels and diversities of expression of the immunoglobulin repertoire expressed by the immunized animal. Typically, if multiple immunizations are given, they will be given one to two months apart.

According to the present invention, an "effective amount" of a therapeutic composition is one which is sufficient to achieve a desired biological effect. Generally, the dosage needed to provide an effective amount of the composition will vary depending upon such factors as the animal's or human's age, condition, sex, and extent of disease, if any, and other variables which can be adjusted by one of ordinary skill in the art.

The antigenic preparations of the invention can be administered by either single or multiple dosages of an effective amount. Effective amounts of the compositions of the invention can vary from 0.01-1,000  $\mu\text{g/ml}$  per dose, more preferably 0.1-500  $\mu\text{g/ml}$  per dose, and most preferably 10-300  $\mu\text{g/ml}$  per dose.

Having now generally described the invention, the same will be more readily understood through reference to the following example which is provided by way of illustration, and is not intended to be limiting of the present invention, unless specified.

### **Examples**

#### ***Example 1: Expression and Purification of *S. pneumoniae* Polypeptides in *E. coli****

The bacterial expression vector pQE10 (QIAGEN, Inc., 9259 Eton Avenue, Chatsworth, CA, 91311) is used in this example for cloning of the nucleotide sequences shown in Table 1 and for expressing the polypeptides identified in Table 1. The components of the pQE10 plasmid are arranged such that the inserted DNA sequence encoding a polypeptide of the present invention expresses the polypeptide with the six His residues (i.e., a "6 X His tag")) covalently linked to the amino terminus.

The DNA sequences encoding the desired portions of the polypeptides of Table 1 are amplified using PCR oligonucleotide primers from either a DNA library constructed from *S. pneumoniae*, such as the one deposited by the inventors at the ATCC for convenience, ATCC Deposit No. 97755, or from

DNA isolated from the same organism such as the *S. pneumoniae* strain deposited with the ATCC as Deposit No. 55840. A list of PCR primers which can be used for this purpose is provided in Table 3, below. The PCR primers anneal to the nucleotide sequences encoding both the amino terminal and carboxy terminal amino acid sequences of the desired portion of the polypeptides of Table 1. Additional nucleotides containing restriction sites to facilitate cloning in the pQE10 vector were added to the 5' and 3' primer sequences, respectively. Such restriction sites are listed in Table 3 for each primer. In each case, the primer comprises, from the 5' end, 4 random nucleotides to prevent "breathing" during the annealing process, a restriction site (shown in Table 3), and approximately 15 nucleotides of *S. pneumoniae* ORF sequence (the complete sequence of each cloning primer is shown as SEQ ID NO:227 through SEQ ID NO:452).

For cloning the polypeptides of Table 1, the 5' and 3' primers were selected to amplify their respective nucleotide coding sequences. One of ordinary skill in the art would appreciate that the point in the protein coding sequence where the 5' primer begins may be varied to amplify a DNA segment encoding any desired portion of the complete amino acid sequences described in Table 1. Similarly, one of ordinary skill in the art would further appreciate that the point in the protein coding sequence where the 3' primer begins may also be varied to amplify a DNA segment encoding any desired portion of the complete amino acid sequences described in Table 1.

The amplified DNA fragment and the pQE10 vector are digested with the appropriate restriction enzyme(s) and the digested DNAs are then ligated together. The ligation mixture is transformed into competent *E. coli* cells using standard procedures such as those described in Sambrook *et al.*, *Molecular Cloning: a Laboratory Manual, 2nd Ed.*; Cold Spring Harbor Laboratory Press, Cold Spring Harbor, N.Y. (1989). Transformants are identified by their ability to grow under selective pressure on LB plates. Plasmid DNA is isolated from resistant colonies and the identity of the cloned DNA confirmed by restriction analysis, PCR and DNA sequencing.

Clones containing the desired constructs are grown overnight ("O/N") in liquid culture under selection. The O/N culture is used to inoculate a large culture, at a dilution of approximately 1:25 to 1:250. The cells are grown to an optical density at 600 nm ("OD600") of between 0.4 and 0.6. Isopropyl-b-D-thiogalactopyranoside ("IPTG") is then added to a final concentration of 1 mM to induce transcription from the *lac* repressor sensitive promoter, by inactivating

the *lacI* repressor. Cells subsequently are incubated further for 3 to 4 hours. Cells are then harvested by centrifugation.

The cells are stirred for 3-4 hours at 4 C in 6M guanidine-HCl, pH 8. The cell debris is removed by centrifugation, and the supernatant containing the protein of interest is loaded onto a nickel-nitrilo-tri-acetic acid ("NiNTA") affinity resin column (available from QIAGEN, Inc., *supra*). Proteins with a 6x His tag bind to the NI-NTA resin with high affinity and can be purified in a simple one-step procedure (for details see: The QIAexpressionist, 1995, QIAGEN, Inc., *supra*). Briefly, the supernatant is loaded onto the column in 6 M guanidine-HCl, pH8, the column is first washed with 10 volumes of 6 M guanidine-HCl, pH8, then washed with 10 volumes of 6 M guanidine-HCl pH6, and finally the polypeptide is eluted with 6 M guanidine-HCl, pH 5.0.

The purified protein is then renatured by dialyzing it against phosphate-buffered saline (PBS) or 50 mM Na-acetate, pH 6 buffer plus 200 mM NaCl. Alternatively, the protein can be successfully refolded while immobilized on the Ni-NTA column. The recommended conditions are as follows: renature using a linear 6M-1M urea gradient in 500 mM NaCl, 20% glycerol, 20 mM Tris/HCl pH7.4, containing protease inhibitors. The renaturation should be performed over a period of 1.5 hours or more. After renaturation the proteins can be eluted by the addition of 250 mM imidazole. Imidazole is removed by a final dialyzing step against PBS or 50 mM sodium acetate pH6 buffer plus 200 mM NaCl. The purified protein is stored at 4°C or frozen at -80°C.

The DNA sequences encoding the amino acid sequences of Table 1 may also be cloned and expressed as fusion proteins by a protocol similar to that described directly above, wherein the pET-32b(+) vector (Novagen, 601 Science Drive, Madison, WI 53711) is preferentially used in place of pQE10.

Each of the polynucleotides shown in Table 1, was successfully amplified and subcloned into pQE10 as described above using the PCR primers shown in Table 3. These pQE10 plasmids containing the DNAs of Table 1, except SP023, SP042, SP054, SP063, SP081, SP092, SP114, SP122, SP123, SP126, and SP127, were deposited with the ATCC as a pooled deposit as a convenience to those of skill in the art. This pooled deposit was desposited on October 16, 1997 and given ATCC Deposit No. 209369. Those of ordinary skill in the art appreciate that isolating an individual plasmid from the pooled deposit is trivial provided the information and reagents described herein. Each of the deposited clones is capable of expressing its encoded *S. pneumoniae* polypeptide.

## Example 2: Immunization and Detection of Immune Responses

### Methods

#### Growth of bacterial inoculum, immunization of Mice and Challenge with *S pneumoniae*.

Propagation and storage of, and challenge by *S. pneumoniae* are performed essentially as described in Aaberge, I.S. et al., Virulence of *Streptococcus pneumoniae* in mice: a standardized method for preparation and frozen storage of the experimental bacterial inoculum, *Microbial Pathogenesis*, 18:141 (1995), incorporated herein by reference.

Briefly, Todd Hewitt (TH) broth (Difco laboratories, Detroit, MI) with 17% FCS, and horse blood agar plates are used for culturing the bacteria. Both broth and blood plates are incubated at 37°C in a 5% CO<sub>2</sub> atmosphere. Blood plates are incubated for 18 hr. The culture broth is regularly 10-fold serially diluted in TH broth kept at room temperature and bacterial suspensions are kept at room temperature until challenge of mice.

For active immunizations C3H/HeJ mice (The Jackson Laboratory, Bar Harbor, ME) are injected intraperitoneally (i.p.) at week 0 with 20 g of recombinant streptococcal protein, or phosphate-buffered saline (PBS), emulsified with complete Freund's adjuvant (CFA), given a similar booster immunization in incomplete Freund's adjuvant (IFA) at week 4, and challenged at week 6. For challenge *S. pneumoniae* are diluted in TH broth from exponentially-growing cultures and mice are injected subcutaneously (s.c.) at the base of the tail with 0.1 ml of these dilutions (serial dilutions are used to find medium infectious dose). Streptococci used for challenge are passaged fewer than six times *in vitro*. To assess infection, blood samples are obtained from the distal part of the lateral femoral vein into heparinized capillary tubes. A 25 ul blood sample is serially 10-fold diluted in TH broth, and 25 ul of diluted and undiluted blood is plated onto blood agar plates. The plates are incubated for 18 hr. and colonies are counted.

Other methods are known in the art, for example, see Langermann, S. et al., *J. Exp. Med.*, 180:2277 (1994), incorporated herein by reference.



### *Immunoassays*

Several immunoassay formats are used to quantify levels of streptococcal-specific antibodies (ELISA and immunoblot), and to evaluate the functional properties of these antibodies (growth inhibition assay). The ELISA and immunoblot assays are also used to detect and quantify antibodies elicited in response to streptococcal infection that react with specific streptococcal antigens. Where antibodies to certain streptococcal antigens are elicited by infection this is taken as evidence that the streptococcal proteins in question are expressed *in vivo*. Absence of infection-derived antibodies (seroconversion) following streptococcal challenge is evidence that infection is prevented or suppressed. The immunoblot assay is also used to ascertain whether antibodies raised against recombinant streptococcal antigens recognize a protein of similar size in extracts of whole streptococci. Where the natural protein is of similar, or identical, size in the immunoblot assay to the recombinant version of the same protein, this is taken as evidence that the recombinant protein is the product of a full-length clone of the respective gene.

### *Enzyme-Linked Immunosorbant Assay (ELISA).*

The ELISA is used to quantify levels of antibodies reactive with streptococcus antigens elicited in response to immunization with these streptococcal antigens. Wells of 96 well microtiter plates (Immunlon 4, Dynatech, Chantilly, Virginia, or equivalent) are coated with antigen by incubating 50  $\mu$ l of 1  $\mu$ g/ml protein antigen solution in a suitable buffer, typically 0.1 M sodium carbonate buffer at pH 9.6. After decanting unbound antigen, additional binding sites are blocked by incubating 100  $\mu$ l of 3% nonfat milk in wash buffer (PBS, 0.2% Tween 20, pH 7.4). After washing, duplicate serial two-fold dilutions of sera in PBS, Tween 20, 1% fetal bovine serum, are incubated for 1 hr, removed, wells are washed three times, and incubated with horseradish peroxidase-conjugated goat anti-mouse IgG. After three washes, bound antibodies are detected with H<sub>2</sub>O<sub>2</sub> and 2,2'-azino-di-(3-ethylbenzthiazoline sulfonate) (Schwan, T.G., *et al.*, *Proc. Natl. Acad. Sci. USA* 92:2909-2913 (1985)) (ABTS®, Kirkegaard & Perry Labs., Gaithersburg, MD) and A405 is quantified with a Molecular Devices, Corp. (Menlo Park, California) Vmax™ plate reader. IgG levels twice the background level in serum from naive mice are assigned the minimum titer of 1:100.

### ***Sodiumdodecylsulfate-Polyacrylamide Gel Electrophoresis (SDS-PAGE) and Immunoblotting***

Using a single well format, total streptococcal protein extracts or recombinant streptococcal antigen are boiled in SDS/2-ME sample buffer before electrophoresis through 3% acrylamide stacking gels, and resolving gels of higher acrylamide concentration, typically 10-15% acrylamide monomer. Gels are electro-blotted to nitrocellulose membranes and lanes are probed with dilutions of antibody to be tested for reactivity with specific streptococcal antigens, followed by the appropriate secondary antibody-enzyme (horseradish peroxidase) conjugate. When it is desirable to confirm that the protein had transferred following electro-blotting, membranes are stained with Ponceau S. Immunoblot signals from bound antibodies are detected on x-ray film as chemiluminescence using ECL™ reagents (Amersham Corp., Arlington Heights, Illinois).

#### ***Example 3: Detection of Streptococcus mRNA expression***

Northern blot analysis is carried out using methods described by, among others, Sambrook *et al.*, *supra*. to detect the expression of the *S. pneumoniae* nucleotide sequences of the present invention in animal tissues. A cDNA probe containing an entire nucleotide sequence shown in Table 1 is labeled with <sup>32</sup>P using the *rediprime*™ DNA labeling system (Amersham Life Science), according to manufacturer's instructions. After labeling, the probe is purified using a CHROMA SPIN-100™ column (Clontech Laboratories, Inc.), according to manufacturer's protocol number PT1200-1. The purified labeled probe is then used to detect the expression of *Streptococcus* mRNA in an animal tissue sample.

Animal tissues, such as blood or spinal fluid, are examined with the labeled probe using ExpressHyb™ hybridization solution (Clontech) according to manufacturer's protocol number PT1190-1. Following hybridization and washing, the blots are mounted and exposed to film at -70 C overnight, and films developed according to standard procedures.

It will be clear that the invention may be practiced otherwise than as particularly described in the foregoing description and examples.

Numerous modifications and variations of the present invention are possible in light of the above teachings and, therefore, are within the scope of the appended claims.

The entire disclosure of all publications (including patents, patent applications, journal articles, laboratory manuals, books, or other documents) cited herein are hereby incorporated by reference.

09765272.012201

Table 1

## SP001 nucleotide (SEQ ID NO:1)

TAAAATCTACGACAATAAAAATCAACTCATTGCTGACTTGGGTTCTGAACGCCGCGTCAATGCCCAAGC  
TAATGATATTCCCACAGATTTGGTTAAGGCAATCGTTTCTATCGAAGACCATCGCTTCTTCGACCACAG  
GGGGATTGATACCATCCGTATCCTGGGAGCTTCTTGCGCAATCTGCAAAGCAATTCCTCCCAAGGTGG  
ATCAACTCTCACCCAACAGTTGATTAAGTTGACTTACTTTTCAACTTCGACTTCCGACCAGACTATTTT  
TCGTAAGGCTCAGGAAGCTTGGTTAGCGATTGAGTTAGAACAAAAAGCAACCAAGCAAGAAATCTTGAC  
CTACTATATAAATAAGGTCTACATGTCTAATGGGAACATGGAATGCAGACAGCAGCTCAAAACTACTA  
TGGTAAAGACCTCAATAATTTAAGTTTACCTCAGTTAGCCTTGCTGGCTGGAATGCCTCAGGCACCAAA  
CCAATATGACCCCTATTACATCCAGAAGCAGCCCAAGACCGCCGAAACTTGGTCTTATCTGAAATGAA  
AAATCAAGGCTACATCTCTGCTGAACAGTATGAGAAAGCAGTCAATACACCAATTACTGATGGACTACA  
AAGTCTCAAATCAGCAAGTAATTACCCTGCTTACATGGATAATTACCTCAAGGAAGTCATCAATCAAGT  
TGAAGAAGAAACAGGCTATAACCTACTCACAACCTGGGATGGATGTCTACACAAATGTAGACCAAGAAGC  
TCAAAAACATCTGTGGGATATTTACAATACAGACGAATACGTTGCCATCCAGACGATGAATTGCAAGT  
CGTTCTTACCATTGTTGATGTTTCTAACGGTAAAGTCATTGCCCAGCTAGGAGCACGCCATCAGTCAAG  
TAATGTTTCTTCGGAATTAACCAAGCAGTAGAACAACCCGCGACTGGGGATCAACTATGAAACCGAT  
CACATACTATGCTTGCCTTGGAGTACGGTGCTTACGATTCAACTGCTACTATCGTTACGATGAGCC  
CTATAACTACCCTGGGACAAATACTCCTGTTTATAACTGGGATAGGGGCTACTTTGGCAACATCACCTT  
GCAATACGCCCTGCAACAATCGCGAAACGTCCCAGCCGTGGAAACTCTAAACAAGGTCCGACTCAACCG  
CGCCAAGACTTTCTTAAATGGTCTAGGAATCGACTACCCAAGTATTCATACTCAAATGCCATTTCAAG  
TAACACAACCGAATCAGACAAAAAATATGGAGCAAGTAGTGAAAAGATGGCTGCTGCTTACGCTGCCTT  
TGCAAATGGTGGAACTTACTATAAACCAATGTATATCCATAAAGTCGTCTTTAGTGATGGGAGTGAAAA  
AGAGTTCTCTAATGTGGAACCTCGTGCCATGAAGGAAACGACAGCCTATATGATGACCGACATGATGAA  
AACAGTCTTGACTTATGGAACCTGGACGAAATGCCTATCTTGCTTGGCTCCCTCAGGCTGGTAAACAGG  
AACCTCTAACTATACAGACGAGGAAATGAAAACACATCAAGACCTCTCAATTTGTAGCACCTGATGA  
ACTATTTGCTGGCTATACGCGTAAATATTCAATGGCTGTATGGACAGGCATTCTAACCGTCTGACACC  
ACTTGTAGGCAATGGCCTTACGGTGCCTGCCAAAGTTTACCGCTCTATGATGACCTACCTGTCTGAAGG  
AAGCAATCCAGAAGATTGGAATATACCAGAGGGGCTCTACAGAAATGGAGAATTCGTATTTAAAAATGG  
TGCTCGTTCTACGTGGAACCTACCTGCTCCACAACAACCCCATCAACTGAAAGTTCAAGCTCATCATC  
AGATAGTTCAACTTCACAGTCTAGCTCAACCACTCCAAGCACAAATAATAGTACGACTACCAATCCTAA  
CAATAATACGCAACAATCAAATACAACCCCTGATCAACAAAATCAGAATCCTCAACCAGCACAAACA

## SP001 AMINO ACID (SEQ ID NO:2)

KIYDNKNQLIADLGSERRVNAQANDIPTDLVKAIVSIEDHRFFDHRGIDTIRILGAFLRNLSNSLQGG  
STLTQQLIKLTYFSTSTSDQTI SRKAQEAWLAIQLEQKATKQEILTYIINKVYMSNGNYGMQTAAQNY  
GKDLNLSLPQLALLAGMPQAPNQYDPYSHPEAAQDRRLVLSMKNQGYISAEQYEKAVNTPITDGLQ  
SLKSASNYPAYMDNYLKEVINQVEEETGYNLLTTGMDVYTNVDQEAQKHLWDIYNTDEYVAYPDDELQV  
ASTIVDVSNKGVIQGLGARHQSSNVSFGINQAVETNRDWGSTMKPITDYAPALEYGVYDSTATIVHDEP  
YNYPGTNTPVYNWDRGYFGNITLQYALQQSRNPVAVETLNKVGLNRKFTLNGLGIDYPSIHYSNAISS  
NTTESDKKYGASSEKMAAAYAAFANGGTYYKPMYIHKVVFSDGSEKEFSNVGTRAMKETTAAYMMTDMMK  
TVLTYGTGRNAYLAWLPQAGKTGTSNYTDEEIEENHIKTSQFVAPDELFAGYTRKYSMAVWVTGYSNRLTP  
LVGNGLTVAKVYRSMMTYLSSESNPEDWNIPEGLYRNGEFVFKNGARSTWNSPAPQPPSTESSSSSS  
DSSTSQSSSTTPSTNNSTTTNPNNNNTQQSNTTDPQQNQNPQPAQP

## SP004 nucleotide (SEQ ID NO:3)

AAATTACAATACGACTATGAATTGACCTCTGGAGAAAAATTACCTCTTCCTAAAGAGATTTTCAAGTTA  
CACTTATATTGGATATATCAAAGAGGGGAAAAACGACTTCTGAGTCTGAAGTAAGTAATCAAAAGAGTTC  
AGTTGCCACTCCTACAAAACAACAAAGGTGGATTATAATGTACACCGAATTTGTAGACCATCCATC  
AACAGTACAAGCTATTGAGGAACAAACACCTGTTTCTTCAACTAAGCCGACAGAAGTTCAAGTAGTTGA  
AAAACCTTTCTCTACTGAATTAATCAATCCAAGAAAGAGAGAAACAATCTTCAGATTCTCAAGAACA  
ATTAGCCGGAACATAAGAATCTAGAAACGAAGAAAGAGGAGAAGATTTCTCCAAAAGAAAAGACTGGGGT  
AAATACATTAAATCCACAGGATGAAGTTTTATCAGGTCAATTGAACAAACCTGAACTCTTATATCGTGA  
GGAAACTATGGAGACAAAAATAGATTTTCAAGAAGAAATTCAGAAAATCCTGATTTAGCTGAAGGAAC  
TGTAAGAGTAAAAACAAGAAGGTAAATTAGGTAAGAAAGTTGAAATCGTCAGAATATTCTCTGTAAACAA  
GGAAGAAGTTTCGCGAGAAATTGTTTCAACTTCAACGACTGCGCCTAGTCCAAGAATAGTCGAAAAGG  
TACTAAAAAACTCAAGTTATAAAGGAACAACCTGAGACTGGTGTAGAACATAAGGACGTACAGTCTGG  
AGCTATTGTTGAACCCGCAATTCAGCCTGAGTTGCCCGAAGCTGTAGTAAGTGACAAAGGCCAACCAGA  
AGTTCAACCTACATTACCCGAAGCAGTTGTGACCGACAAAGGTGAGACTGAGGTTCAACCAGAGTCGCC  
AGATACTGTGGTAAGTGATAAAGGTGAACCAGAGCAGGTAGCACCGCTTCAGAATATAAGGGTAATAT

Table 1

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TGAGCAAGTAAAACCTGAAACTCCGGTTGAGAAGACCAAAGCAAGGTCCAGAAAAAACTGAAGAAGT  
TCCAGTAAAACCAACAGAAGAAACACCAGTAAATCCAAATGAAGGTACTACAGAAGGAACCTCAATTCA  
AGAAGCAGAAAAATCCAGTTCAACCTGCAGAAGAATCAACAACGAATTCAGAGAAAGTATCACCAGATAC  
ATCTAGCAAAAAATACTGGGGAAGTGTCCAGTAATCCTAGTGATTTCGACAACCTCAGTTGGAGAATCAAA  
TAAACCAGAACATAATGACTCTAAAAATGAAAATTCAGAAAAAACTGTAGAAGAAGTTCAGTAAATCC  
AAATGAAGGCACAGTAGAAGGTACCTCAAATCAAGAAACAGAAAAACCAGTTCAACCTGCAGAAGAAAC  
ACAAACAAACTCTGGGAAAATAGCTAACGAAAATACTGGAGAAGTATCCAATAAACCTAGTGATTCAAA  
ACCACCAGTTGAAGAATCAAATCAACCAGAAAAAAACGGAACCTGCAACAAAACCAGAAAATTCAGGTAA  
TACAACATCAGAGAATGGACAAACAGAACCAGAACCATCAAACGGAAATTCAACTGAGGATGTTTCAAC  
CGAATCAAACACATCCAATTCAAATGGAAACGAAGAAATTAACAAGAAAATGAAC TAGACCCTGATAA  
AAAGGTAGAAGAACCAGAGAAAACACTTGAATTAAGAAATGTTTCCGACCTAGAGTTA

**SP004 amino acid (SEQ ID NO:4)**

NYNTDYELTSGEKLPLPKEISGYTYIGYIKEGKTTSESEVSNQKSSVATPTKQKQVDYINVTPNFVDHPS  
TVQAIQEQTTPVSSTKPTVEVQVVEKPFSTELINPRKEEKQSSDSQEQLAEHKNLETKKEEKISPKEKTV  
NTLNPQDEVLGQLNKPPELLYREETMETKIDFQEEIQENPDLAEGTVRVKQEGKLGKKVEIVRIFSVNK  
EEVSREIVSTSTTAPSPRIVEKGTKKTVIKQEPETGVEHKDVQSGAIVEPAIQPELPEAVVSDKGEPE  
VQPTLPEAVVTDKGETEVQPEPDTVVSDKGEPEQVAPLPEYKGNIEQVKPETPVEKTKEQGPEKTEEV  
PVKPTETFPVNPNEGTTGEGTSIQEAENPVQPAEESTTNSEKVPDTSKNTGEVSSNPDSSTTSVGESN  
KPEHNSKENSEKTVEEVVNPNEGTVGEGTSNQETEKVPQPAEETQTNSGKIANENTGEVSNKPSDSK  
PPVEESNQPEKNGTATKPENSGNTTSENGQTEPEPSNGNSTEDVSTESNTSNSNGNEEIKQENELDPDK  
KVEEPEKTLRLNVSLEL

**SP006 nucleotide (SEQ ID NO:5)**

TGAGAATCAAGCTACACCCAAAGAGACTAGCGCTCAAAAGACAATCGTCCTTGCTACAGCTGGCGACGT  
GCCACCATTTGACTACGAAGACAAGGGCAATCTGACAGGCTTTGATAATCGAAGTTTTAAAGGCAGTAGA  
TGAAAAACTCAGCGACTACGAGATTCAATTCCAAAGAACCCTGGGAGAGCATCTTCCCAGGACTTGA  
TTCTGGTCACTATCAGGCTGCGGCCAATAACTTGAGTTACACAAAAGAGCGTGCTGAAAAATACCTTTA  
CTCGCTTCCAATTTCCAACAATCCCCTCGTCCTTGTCAGCAACAAGAAAAATCCTTTGACTTCTCTTGA  
CCAGATCGCTGGTAAACAACACAAGAGGATACCGGAACCTTCTAACGCTCAATTCATCAATAACTGGAA  
TCAGAAACACACTGATAATCCCGCTACAATTAATTTTCTGGTGAGGATATTGGTAAACGAATCCTAGA  
CCTTGCTAACGGAGAGTTTGATTTCCTAGTTTTTGACAAGGTATCCGTTCAAAGATTATCAAGGACCG  
TGGTTTTAGACCTCTCAGTCGTTGATTTACCTTCTGCAGATAGCCCCAGCAATTATATCATTTTTCTCAAG  
CGACCAAAAAGAGTTTAAAGAGCAATTTGATAAAGCGCTCAAAGAACTCTATCAAGACGGAACCCCTGA  
AAAACCTCAGCAATACCTATCTAGGTGGTTCTTACCTCCCAGATCAATCTCAGTTACAA

**SP006 amino acid (SEQ ID NO:6)**

ENQATPKETSAQKTIVLATAGDVPPFDYEDKGNLTGFDIEVLKAVDEKLSDYEIQFQRTAWESIFPGLD  
SGHYQAAANNLSYTKERAKEYLYSLPISNNPLVLVSNKKNPLTSLDQIAGKTTQEDTGT SNAQFINNWN  
QKHTDNPATINFSGEDIGKRILDLANGEFDLFLVFDKVSQKIIKDRGLDLSVDLPADSPSNYIIFSS  
DQKEFKEQFDKALKELYQDGTLEKLSNTYLGGSYLPDQSQLQ

**SP007 nucleotide (SEQ ID NO:7)**

TGGTAACCGCTCTTCTCGTAACGCAGCTTCATCTTCTGATGTGAAGACAAAAGCAGCAATCGTCACTGA  
TACTGGTGGTGTGATGACAAATCATTCAACCAATCAGCTTGGGAAGGTTTGCAGGCTTGGGGTAAAGA  
ACACAATCTTTCAAAGATAACGGTTTCACTTACTTCCAATCAACAAGTGAAGCTGACTACGCTAACAA  
CTTGCAACAAGCGGCTGGAAGTTACAACCTAATCTTCGGTGTGGTTTTGCCCTTAATAATGCAGTTAA  
AGATGCAGCAAAAAGAACACACTGACTTGAAGTATGTCTTGATTGATGATGTGATTAAAGACCAAAAAGAA  
TGTTGCGAGCGTAACCTTCGCTGATAATGAGTACAGGTACCTTGCAGGTGTGGCTGCAGCAAAAACAA  
TAAGACAAAACAAGTTGGTTTTGTAGGTGGTGAAGTGAAGTTATCTCTCGTTTTGAAGCAGGATT  
CAAGGCTGGTGTGCGTCAGTAGACCCATCTATCAAAGTCCAAGTTGACTACGCTGGTTTCAATTTGGTGA  
TGCGGCTAAAGGTAAACAATTGCAGCCGCACAATACGCAGCCGGTGCAGATATTGTTTACCAAGTAGC  
TGGTGGTACAGGTGCAGGTGTCTTTGCAGAGGCAAAAATCTCTCAACGAAAGCCGCTCTGAAAATGAAA  
AGTTTGGGTTATCGGTGTGATCGTGACCAAGAAGCAGAAGGTAAATACACTTCTAAAGATGGCAAAGA  
ATCAAACCTTTGTTCTGTATCTACTTTGAAACAAGTTGGTACAACGTGAAAAGATATTTCTAACAAGGC  
AGAAAGAGGAGAATTCCTTGGCGGTCAAGTGATCGTTTACTCATTGAAGGATAAAGGGTTGACTTGGC  
AGTAACAAACCTTTTCAAGAAGGTAAAAAAGCTGTGCAAGATGCAAAAGCTAAAATCCTTGATGGAAG  
CGTAAAGTTCTTGA

Table 1

**SP007 amino acid (SEQ ID NO:8)**

GNRSSRNAASSSDVKTKAAIVTDTGGVDDKSFNQSAWEGQLQAWGKEHNLSKDNFTYFQSTSEADYANN  
LQQAAGSYNLIFGVGFALNNVAKDAKEHTDLNLYVLIDDVIKDQKNVASVTFADNESGYLAGVAAAKTT  
KTKQVGFVGGIESEVISRFEAGFKAGVASVDPSIKVQVDYAGSFGDAAGKGTIAAAQYAAGADIVYQVA  
GGTGAGVFAEAKSLNESRPENKVVVIGVDRDQEAEGKYTSKDGKESNFVLVSTLKQVGTTVKDISNKA  
ERGEFFGGQVIVYSLKDKGVDLAVTNLSEEGKKAVEDAKAKILDGSKVKVPEK

**SP008 nucleotide (SEQ ID NO:9)**

TGTGGAATTTGACAGGTAACAGCAAAAAAGCTGCTGATTGAGGTGACAAACCTGTTATCAAAATGTAC  
CAAAATCGGTGACAAACCAGACAACCTGGATGAATTGTTAGCAAATGCCAACAAAATCATTGAAGAAAA  
GTTGGTGCCAAATGGAATATCCAATACCTTGGCTGGGGTGACTATGGTAAGAAAATGTCAGTTATCACA  
TCATCTGGTGAAACTATGATATTGCCTTTGCAGATAACTATATTGTAAATGCTCAAAAAGGTGCTTAC  
GCTGACTTGACAGAATTGTACAAAAAGAAGGTAAAGACCTTTACAAAGCACTTGACCCAGCTTACATC  
AAGGTAATACTGTAAATGGTAAGATTACGCTGTTCCAGTTGCAGCCAACGTTGCATCATCTCAAAAC  
TTTGCTTCAACCGAAGCTCTCCTTGCTAAATATGGTATCGATATTTTCAGGTGTTACTTCTTACGAACT  
CTTGAGCCAGTCTTGAAACAAATCAAGAAAAAGCTCCAGACGTAGTACCATTGCTATTGGTAAAGTT  
TTCATCCCATCTGATAATTTTGACTACCCAGTAGCAAACGGTCTTCCATTGCTTATCGACCTTGAAGGC  
GATACTACTAAAGTTGTAAACCGTTACGAAGTGCTCGTTTCAAAGAACACTTGAAGACTCTTCAACAA  
TTCTATGAAGCTGGCTACATTCCAAAAGACGTGCAACAAGCGATACTTCTTTGACCTTCAACAAGAT  
ACTTGGTTCGTTCTGTAAGAAACAGTAGGACCAGCTGACTACGGTAACAGCTTGCTTTCACGTGTTGCC  
AACAAAGATATCCAAATCAAACCAATTACTAATTCTCATCAAGNAAAACCAACAACACAAGTTGCTAAC  
TTTGTCATCTCAACAACCTCTAAGAACAAGAAAAATCAATGGAAATCTTGAACCTCTTGAATACGAAC  
CCAGAACTCTTGAACGGTCTTGTGTTACGGTCCAGAAGGCAAGAACTGGGAAAAAATTGAAGGTAAAGAA  
AACCCTGTTTCGCTTCTTGATGGCTACAAAGGAAACACTCACATGGGTGGATGGAACACTGGTAACAAC  
TGGATCCTTTACATCAACGAAAACGTTACAGACCAACAAATCGAAAATTCTAAGAAAGAATTGGCAGAA  
GCTAAAGAATCTCCAGCGCTTGGATTTATCTTCAATACTGACAATGTGAAATCTGAAATCTCAGCTATT  
GCTAACACAATGCAACAATTGATACAGCTATCAACACTGGTACTGTAGACCCAGATAAAGCGATTCCA  
GAATTGATGGAAAAATTGAAATCTGAAGGTGCCTACGAAAAAGTATTGAACGAAATGCAAAAACAATAC  
GATGAATTCTTGAAAAACAAAAAA

**SP008 amino acid (SEQ ID NO:10)**

CGNLTGNSKKAADSGDKPVIKMYQIGDKPDNLDELLANANKIIEEKVGAKLDIQYLGWGDYGGKMSVIT  
SSGENYDIAFADNYIVNAQKGAYADLTLEYKKEGKDLYKALDPAYIKGNTVNGKIYAVPVAANVASSQN  
FAFNGTLLAKYGIDISGVTSYETLEPVVKQIKEKAPDVVPFAIGKVFIPSDNFDYPVANGLPFVIDLEG  
DTTKVVRNRYEVRPFKEHLKTLHKFYEAGYIPKDVATSDTSFDLQQDTWVREETVGPADYGNLLSRVA  
NKDIQIKPITNFIKXNQTTQVANFVISNNSKNKEKSMEILNLLNTNPELLNGLVYGPEGKNWEKIEGKE  
NRVRVLDGYKGNTHMGGWNTGNNWILYINENVTDQOIENSKKELAEAKESPALGFIFNTDNVKSEISAI  
ANTMQQFDTAINTGTVPDKAIPELMEKLKSEGAYEKVLNEMQKQYDEFLKNKK

**SP009 nucleotide (SEQ ID NO:11)**

TGGTCAAGGAAGTCTTCTAAAGACAACAAAGAGGCAGAACTTAAGAAGGTTGACTTTATCCTAGACTG  
GACACCAAAATACCAACCACACAGGGCTTTATGTTGCCAAGGAAAAAGGTTATTTCAAAGAAGCTGGAGT  
GGATGTTGATTTGAAATTGCCACCAGAAGAAAGTTCTTCTGACTTGGTTATCAACGGAAAGGCACCATT  
TGCAGTGATTTTCCAAGACTACATGGCTAAGAAATTGGAAAAAGGAGCAGGAATCACTGCCGTTGCAGC  
TATTGTTGAACACAATACATCAGGAATCATCTCTCGTAAATCTGATAATGTAAGCAGTCCAAAAGACTT  
GGTTGGTAAGAAATATGGGACATGGAATGACCCAAGCTGAACTTGCTATGTTGAAAACCTTGGTAGAATC  
TCAAGGTGGAGACTTTTGAGAAGGTTGAAAAGACTACCAAAATAACGACTCAAACTCAATCACACCGATTGC  
CAATGGCGTCTTTGATACCTGCTTGGATTTACTACGGTTGGGATGGTATCCTTGCTAAATCTCAAGGTGT  
AGATGCTAACTTTCATGTACTTGAAAGACTATGTCAAGGAGTTTGACTACTATTACACAGTTATCATCGC  
AAACAACGACTATCTGAAAGATAACAAAGAAGAAGCTCGCAAAGTCATCCAAGCCATCAAAAAAGGCTA  
CCAATATGCCATGGAACATCCAGAAGAAGCTGCAGATATTCTCATCAAGAATGCACCTGAACTCAAGGA  
AAAACGTGACTTTGTCTATCGAATCTCAAAAATACTTGTCAAAAGAATACGCAAGCGACAAGGAAAAATG  
GGGTCAATTTGACGCAGCTCGCTGGAATGCTTTCTACAAATGGGATAAAGAAAAATGGTATCCTTAAAGA  
AGACTTGACAGACAAAGGCTTACCAACGAATTTGTGAAA

**SP009 amino acid (SEQ ID NO:12)**

Table 1

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QGGTASNDKNEAEKKVDFILDWTPNTNHTGLYVAKEKGYFKEAGVDVDLKLPPPESSSDLVINGKAPF  
AVYFQDYMAKKLEKGAGITAVAAIVEHNTSGIISRKSDNVSSPKDLVGKKYGTWNDPTELAMKTLVES  
QGGDFEKVEKVPNNDSNSITPIANGVFDTAWIYYGWDGILAKSQGVNDANFMYLKDYVKEFDYYSPIVIA  
NNDYLDKNKEEARKVIQAIKKGYQYAMEHPPEEAADILIKNAPELKEKRDFVIESQKYLSEYASDKEKW  
QQFDAARWNAFYKWDKENGILKEDLTDKGFTNEFVK

**SP010 nucleotide (SEQ ID NO:13)**

TAGCTCAGGTGGAACGCTGGTTCATCCTCTGGAACCACTGCCAAAGCTCGCACTATCGATGAAAT  
CAAAAAAGCGGTGAACCTGCCAATCGCCGTGTTTGGAGATAAAAAACCGTTTGGCTACGTTGACAATGA  
TGGTTCACCAAGGTACGCTACGATATTGAACCTAGGGAACCACTAGCTCAAGACCTTGGTGTCAAGGT  
TAAATACATTTACAGTAACCTGACGACGTAAGAAACAAGTTGATTTCAAACAAGGTAGATATTACTCT  
TGCTAACTTTACAGTAACCTGACGACGTAAGAAACAAGTTGATTTCGCTTCCATATATGAAAGTTTC  
TCTGGGTGTCGTATCACCTAAGACTGGTCTCATTACAGACGTCAAACAACCTTGAAGGTAAACCTTAAT  
TGTCACAAAAGGAACGACTGCTGAGACTTATTTTGAAGAAATCATCCAGAAATCAAACCTCAAAAATA  
CGACCAATACAGTGACTCTTACCAAGCTCTTCTTGACGGACGTGGAGATGCCTTTTCAACTGACAATAC  
GGAAGTTCTAGCTTGGGCGCTTGAAGATAAAGGATTTGAAGTAGGAATTACTTCCCTCGGTGATCCCGA  
TACCATTGCGGCAGCAGTTCAAAAAGGCAACCAAGAATTGCTAGACTTCATCAATAAAGATATTGAAAA  
ATTAGGCAAGGAAAACCTTCTTCCACAAGGCCTATGAAAAGACACTTCACCAACCTACGGTGACGCTGC  
TAAAGCAGATGACCTGGTTGTTGAAGGTGGAAGTTGAT

**SP010 amino acid (SEQ ID NO:14)**

SSGGNAGSSSGKTTAKARTIDEIKKSGELRIAVFGDKKPFYVDNDGSTKVRDYIELGNQLAQDLGVKV  
KYISVDAANRAEYLISNKVDITLANFTVTDERKKQVDFALPYMKVSLGVVSPKTGLITDVKQLEGKTLI  
VTKGTTAETYFEKNHPEIKLQKYDQYSDSYQALLDGRGDAFSTDNTEVLAWALENKGFVEVGITSLGDPD  
TIAAAVQKGNQELDLDFINKDIEKLGKENFFHKAYEKT LHPTYGDAAKADDLVVEGGKVD

**SP011 nucleotide (SEQ ID NO:15)**

CTCCAACCTATGGTAAATCTGCGGATGGCACAGTGACCATCGAGTATTTCAACCAGAAAAAGAAATGAC  
CAAAACCTTGGAAGAAATCACTCGTGATTTTGAAGAAGAAAACCTTAAGATCAAGGTCAAAGTCGTCAA  
TGTAACCAATGCTGGTGAAGTATTGAAGACACGCGTTCTCGCAGGAGATGTGCCTGATGTGGTCAATAT  
TTACCCACAGTCCATCGAAGTGAAGAATGGGCAAAAAGCAGGTGTTTTTGAAGATTTGAGCAACAAAGA  
CTACCTGAAACGCGTGAAAAATGGCTACGCTGAAAAATATGCTGTAAACGAAAAAGTTTACAACGTTCC  
TTTTACAGCTAATGCTTATGGAATTTACTACAACAAAGATAAATTCGAAGAAGTGGGCTTGAAGGTTCC  
TGAAACCTGGGATGAATTTGAACAGTTAGTCAAAGATATCGTTGCTAAAGGACAAACACCATTGGAAT  
TGCAGGTGCAGATGCTTGGACACTCAATGGTTACAATCAATTAGCCTTTGCGACAGCAACAGGTGGAGG  
AAAAGAAGCAAATCAATACCTTCGTTATTCTCAACCAAATGCCATTAAATTGTCGGATCCGATTATGAA  
AGATGATATCAAGGTCATGGACATCCTTCGCATCAATGGATCTAAGCAAAGAAGTGGGAAGGTGCTGG  
CTATACCGATGTTATCGGAGCCTTCGCACGTGGGGATGTCCTCATGACACCAAATGGGTCTTGGGCGAT  
CACAGCGATTAATGAACAAAACCGAAGCTTTAAGATTGGGACCTTCATGATTCCAGGAAAAAGAAAAAGG  
ACAAAGCTTAACCGTTGGTGCGGGGAGACTTGGCATGGTCTATCTCAGCCACCACCAAACATCCAAAAGA  
AGCCAATGCCTTTGTGGAATATATGACCCGTCCAGAAGTCATGCAAAAATACTACGATGTGGACGGATC  
TCCAACAGCGATCGAAGGGGTCAAACAAGCAGGAGAAGATTACCGCTTGCTGGTATGACCGAATATGC  
CTTTACGGATCGTCACTTGGTCTGGTTGCAACAATACTGGACCAGTGAAGCAGACTTCCATACCTTGAC  
CATGAAGTATGTCTTGACCGGTGATAAACAAGGCATGGTCAATGATTGATGCCTTCTTTAACCCGAT  
GAAAGCGGATGTGGAT

**SP011 amino acid (SEQ ID NO:16)**

SNYKSADGTVTIEYFNQKKEMTKTLEEITRDFEKENPKIKVKVVNVPNAGEVLKTRVLADVPDVVNI  
YPQSIELQEWAKAGVFEDLSNKDYLRVKNKYAEKYAVNEKVYNVPFTANAYGIYYNKDKFEELGLKVP  
ETWDFEQLVKDIVAKGQTPFGIAGADAWTLNGYNQLAFATATGGGKEANQYLYRSQPNAIKLSDFIMK  
DDIKVMDILRINGSKQKNWEGAGYTDVIGAFARGDVLMTPNGSWAITAINEQKPNFKIGTFMIPGKEKG  
QSLTVGAGDLAWSISATTKHPKEANAFVEYMTREVMQKYVDVGSPTAIEGVKQAGEDSPLAGMTEYA  
FTDRHLVWLQQYWTSEADFHTLTMNYVLTGDKQGMVNDLNAFFNPMKADVD

**SP012 nucleotide (SEQ ID NO:17)**

TGGGAAAAATTCTAGCGAACTAGTGGAGATAATTGGTCAAAGTACCAGTCTAACAAGTCTATTACTAT  
TGGATTTGATAGTACTTTTGTTCGAATGGGATTTGCTCAGAAAGATGGTCTTATGCAGGATTTGATAT  
TGATTTAGCTACAGCTGTTTTTGAAGAAATACGGAATCACGGTAAATTGGCAACCGATTGATTGGGATTT

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Table 1

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GAAAGAAGCTGAATTGACAAAAGGAACGATTGATCTGATTTGGAATGGCTATTCCGCTACAGACGAACG  
CCGTGAAAAGGTGGCTTTTCAGTAACATCATATATGAAGAAATGAGCAGGTATTGGTTACGAAGAAATCATC  
TGGTATCACGACTGCAAAGGATATGACTGGAAAAGACATTAGGAGCTCAAGCTGGTTTCATCTGGTTATGC  
GGACTTTGAAGCAAATCCAGAAATTTTGAAGAATATTGTCGCTAATAAGGAAGCGAATCAATACCAAAC  
CTTTAATGAAGCCTTGATTGATTTGAAAAACGATCGAATTGATGGTCTATTGATTGACCGTGTCTATGC  
AAACTATTATTTAGAAGCAGAAGGTGTTTTAAACGATTATAATGTCTTTACAGTTGGACTAGAAACAGA  
AGCTTTTGCGGTGGAGCCCGTAAGGAAGATACAACTTGGTTAAGAAGATAAATGAAGCTTTTTCTAG  
TCTTTACAAGGACGGCAAGTTCCAAGAAATCAGCCAAAAATGGTTTGGAGAAGATGTAGCAACCAAAGA  
AGTAAAGAAGGACAG

**SP012 nucleotide (SEQ ID NO:18)**

GKNSSETSGDNWSKYQSNKSITIGFDSTFVPMGFAQKDGSYAGFDIDLATAVFEKYGITVNWQPIDWDL  
KEAELTKGTIDLIWNGYSATDERREKVAFSNSYMKNEQVLVTKSSGITAKDMTGKTLGAQAGSSGYA  
DFEANPEILKNIVANKEANQYQTFNEALIDLKNDRIDGLLIDRVYANYYLEAEGVLNDYNVFTVGLETE  
AFAVGARKEDTNLVKKINEAFSSLYKDGKFQEISQKWFGEDEVATKEVKEGQ

**SP013 nucleotide (SEQ ID NO:19)**

TGCTAGCGGAAAAAAGATACAACTTCTGGTCAAAAACATAAAAGTTGTTGCTACAACTCAATCATCGC  
TGATATTAATAAAAATATTGCTGGTGACAAAATTGACCTTCATAGTATCGTTCCGATTGGGCAAGACCC  
ACACGAATACGAACCACTTCCTGAAGACGTTAAGAAAACCTCTGAGGCTAATTTGATTTTCTATAACGG  
TATCAACCTTGAAACAGGTGGCAATGCTTGGTTTACAAAATTGGTAGAAAATGCCAAGAAAACCTGAAAA  
CAAAGACTACTTCGCAGTCAGCGACGGCGTTGATGTTATCTACCTTGAAGGTCAAATGAAAAAGGAAA  
AGAAGACCCACACGCTTGGCTTAACCTTGAAAACGGTATTATTTTGCATAAAATATCGCCAAACAATT  
GAGCGCCAAAGACCCTAACAATAAAGAATTCTATGAAAAAATCTCAAAGAATATACTGATAAGTTAGA  
CAAACCTTGATAAAGAAAGTAAGGATAAATTTAATAAGATCCCTGCTGAAAAGAACTCATTGTAACCAG  
CGAAGGAGCATTCAAATACTTCTCTAAAGCCTATGGTGTCCCAAGTGCTTACATCTGGGAAATCAATAC  
TGAAGAAGAAGGAACCTCTGAACAAATCAAGACCTTGGTTGAAAACCTTCGCCAAACAAAAGTTCCATC  
ACTCTTTGTAGAATCAAGTGTGGATGACCGTCCAATGAAAACCTGTTTCTCAAGACACAAACATCCCAAT  
CTACGCTCAAATCTTTACTGACTCTATCGCAGAACAAGGTAAAGAAGGCGACAGCTACTACAGCATGAT  
GAAATACAACCTTGACAAGATTGCTGAAGGATTGGCAAAA

**SP013 amino acid (SEQ ID NO:20)**

ASGKKDTSQGKLKVVATNSIIADITKNIAGDKIDLHSIVPIGQDPHEYEPLPEDVKKTSEANLIFYNG  
INLETGGNAWFTKLVENAKKTENKDYFAVSDGVDVIYLEGQNEKGKEDPHAWLNLENGIIFAKNIAKQL  
SAKDPNNKEFYEKNLKEYTDKLDKDKESKDKFNKIPAEKKLIVTSEGAFKYFSKAYGVPSAYIWEINT  
EEEGTPEQIKTLVEKLRQTKVPSLFVSSVDDRPMTVSQDTNIPYIAQIFTDSIAEQGKEGDSYYSMM  
KYNLDKIAEGLAK

**SP014 nucleotide (SEQ ID NO:21)**

TGGCTCAAAAATACAGCTTCAAGTCCAGATTATAAGTTGGAAGGTGTAACATTCCCGCTTCAAGAAAA  
GAAAACATTGAAGTTTATGACAGCCAGTTCACCGTTATCTCCTAAAGACCCAAATGAAAAGTTAATTTT  
GCAACGTTTGGAGAAGGAACTGGCGTTCATATTGACTGGACCAACTACCAATCCGACTTTGCAGAAAA  
ACGTAACCTGGATATTTCTAGTGGTGATTTACCAGATGCTATCCACAACGACGGAGCTTCAGATGTGGA  
CTTGATGAACTGGGCTAAAAAAGGTGTTATTATTCAGTTGAAGATTGATTGATAAATACATGCCAAA  
TCTTAAGAAAATTTTGGATGAGAAACAGAGTACAAGGCCTTGATGACAGCACCTGATGGGCACATTTA  
CTCATTTCATGGATTGAAGAGCTTGGAGATGCTAAAGAGTCTATTACAGTGTCAACGATATGGCTTG  
GATTAACAAAGATTGGCTTAAGAACTTGGTCTTGAAATGCCAAAACCTACTGATGATTTGATTAAAGT  
CCTAGAAGCTTTCAAAAACGGGGATCCAAATGGAAATGGAGAGGCTGATGAAATTCCATTTTCAATTTAT  
TAGTGGTAACGGAAACGAAGATTTTAAATTCCTATTTGCTGCATTTGGTATAGGGGATAACGATGATCA  
TTTAGTAGTAGGAAATGATGGCAAAGTTGACTTCACAGCAGATAACGATAACTATAAAGAAGGTGTCAA  
ATTTATCCGTCAATTGCAAGAAAAAGGCCTGATTGATAAAGAAGCTTTCGAACATGATTGGAATAGTTA  
CATTGCTAAAGGTCATGATCAGAAATTTGGTGTCTTACTTTACATGGGATAAGAATAATGTTACTGGAAG  
TAACGAAAGTTATGATGTTTTACCAGTACTTGCTGGACCAAGTGGTCAAAAACACGTAGCTCGTACAAA  
CGGTATGGGATTTGCACGTGACAAGATGGTTATTACCAGTGTAACAAAAACCTAGAATTGACAGCTAA  
ATGGATTGATGCACAATACGCTCCACTCCAATCTGTGCAAAATAACTGGGGAACTTACGGAGATGACAA  
ACAACAAAACATCTTTGAATTGGATCAAGCGTCAAATAGTCTAAAACACTTACCCTAAACGGAAGTGC  
ACCAGCAGAACTTCGTCAAAAGACTGAAGTAGGAGGACCCTAGCTATCCTAGATTTCATACTATGGTAA  
AGTAACAACCATGCCTGATGATGCCAAATGGCGTTTGGATCTTATCAAAGAATATTATGTTTCCTTACAT

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Table 1

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GAGCAATGTCAATAACTATCCAAGAGTCTTTATGACACAGGAAGATTGGACAAGATTGCCCATATCGA  
AGCAGATATGAATGACTATATCTACCGTAAACGTGCTGAATGGATTGTAAATGGCAATATTGATACTGA  
GTGGGATGATTACAAGAAAGAACTTGAAAAATACGGACTTTCTGATTACCTCGCTATTAAACAAAAATA  
CTACGACCAATACCAAGCAAACAAAAAC ---

**SP014 amino acid (SEQ ID NO:22)**

GSKNTASSPDYKLEGVTFPLQEKKTLKFMTASSPLSPKDPNEKLILQRLEKETGVHIDWTNYQSDFAEK  
RNLDISSGDLPAIHNDGASDVLDLMNWAKKGVIIIPVEDLIDKYPNLKKILDEKPEYKALMTAPDGHYI  
SFPWIEELGDGKESIHSVNDMAWINKDWLKKLGLEMPKTTDDLKIVLEAFKNGDPNGNGEADIPIFSFI  
SGNGNEDFKFLFAAFGIGDNDHLLVVGNDGKVDFTADNDNYKEGVKFI RQLQEKGLIDKEAFEHDWNSY  
IAKGHQKFGVYFTWDKNNVTGSNESYDVLVPLAGPSGQKHVARTNGMGFARDKMTSVNKNLELTAK  
WIDAQYAPLQSVQNNWGTYGDDKQONIFELDQASNSLKHPLNGTAPAE LRQKTEVGGPLAILDSYYGK  
VTTMPDDAKWRDLIKEYYVPYMSNVNNYPRVMTQEDLDKIAHIEADMNDYIYKRKRAEWIVNGNIDTE  
WDDYKKELEKYGLSDYLAIKQKYDQYQANKN

**SP015 nucleotide (SEQ ID NO:23)**

TAGTACAACTCAAGCACTAGTCAGACAGAGACCAGTAGCTCTGCTCCAACAGAGGTAACCATTAAG  
TTCACTGGACGAGGTCAAACCTTTCCAAAGTCTCTGAAAAGATTGTGACCTTTGACCTCGGCGCTGCGGA  
TACTATTCGCGCTTTAGGATTTGAAAAAATATCGTCGGAATGCCTACAAAACCTGTTCCGACTTATCT  
AAAAGACCTAGTGGGAAGTGTCAAAAATGTTGGTCTATGAAAGAACCTGATTTAGAAGCTATCGCCGC  
CCTTGAGCCTGATTTGATTATCGCTTCGCCACGTACACAAAATTCTGTAGACAAATTCAAAGAAATCGC  
CCCAACCGTTCTCTTCCAAGCAAGCAAGGACGACTACTGGACTTCTACCAAGGCTAATATCGAATCCTT  
AGCAAGTGCCTTCGGCGAAACTGGTACACAGAAAGCCAAGGAAGAATTGACCAAGCTAGACAAGAGCAT  
CCAAGAAGTCGCTACTAAAAATGAAAGCTCTGACAAAAAAGCCCTTGCGATCCTCTTAATGAAGGAAA  
AATGGCAGCCTTTGGTGCCAAATCTCGTTTCTCTTTCTTGTACCAAACCTTGAAATTCAAACCAACTGA  
TACAAAATTTGAAGACTCACGCCACGGACAAGAAGTCAGCTTTGAAAGTGTCAAAGAAATCAACCCTGA  
CATCCTCTTTGTTCATCAACCGTACCCTTGCCATCGGTGGGGACAACCTCTAGCAACGACGGTGTCTTAGA  
AAATGCCCTTATCGCTGAAACACCTGCTGCTAAAAATGGTAAGATTATCCAATAACACCAGACCTCTG  
GTATCTAAGCGGAGGCGGACTTGAATCAACAAAACCTCATGATTGAAGACATACAAAAGCTTTGAAA

**SP015 amino acid (SEQ ID NO:24)**

STNSSTSQTETSSAPTEVTIKSSLDEVKLSKVPEKIVTFDLGAADTIRALGF EK NIVGMPTKTVPTYL  
KDLVGT VKNV GSMKEPDLEAIAALEPDLIIASPR TQKFVDKFKEIAPT VLFQASKDDYWTSTKANIESL  
ASAFGETGTQKAKEELTKL DKS IQEVATKNES SDKKALAILLNEGKMAAFGAKSRFSFLYQTLKFKPTD  
TKFEDSRHQEVSFESVKEINPDILFVINRTLAIGGDNSSNDGVLENALIAETPAAKNGKIIQLTPDLW  
YLSGGGLESTKLMIEDIQKALK

**SP016 nucleotide (SEQ ID NO:25)**

TGGCAATTCTGGCGGAAGTAAAGATGCTGCCAAATCAGGTGGTGACGGTGCCAAAACAGAAATCACTTG  
GTGGGCATTCCAGTATTTACCCAAGAAAAAAGTGGTGACGGTGTGGAACCTATGAAAAATCAATCAT  
CGAAGCGTTTGAAAAAGCAAACCCAGATATAAAAGTGAAATTGGAACCATCGACTTCAAGTCAGGTCC  
TGAAAAAATCACAACAGCCATCGAAGCAGGAACAGCTCCAGACGTACTCTTTGATGCACCAGGACGTAT  
CATCCAATACGGTAAAAACGGTAAATTTGGCTGAGTTGAATGACCTCTTCACAGATGAATTTGTTAAAGA  
TGTCACAATGAAAACATCGTACAAGCAAGTAAAGCTGGAGACAAGGCTTATATGTATCCGATTAGTTC  
TGCCCCATTCTACATGGCAATGAACAAGAAAATGTTAGAAGATGCTGGAGTAGCAAACCTTGTAAGA  
AGGTTGGACAACCTGATGATTTTGAAAAAGTATTGAAAGCACTTAAAGACAAGGTTACACACCAGGTTT  
ATTGTTTCAGTTCTGGTCAAGGGGGAGACCAAGGAACACGTGCCTTTATCTCTAACCTTTATAGCGGTTT  
TGTAACAGATGAAAAAGTTAGCAAATATACAACGTATGATCTCTAAATTCGTCAAAGGCTTTGAAAAAGC  
AACTAGCTGGATTAAAGACAATTTGATCAATAATGGTTTACAATTTGACGGTGGGGCAGATATCCAAAA  
CTTTGCCAACGGTCAAACATCTTACACAATCTTTGGGCACCAGCTCAAAATGGTATCCAAGCTAAACT  
TTTGAAGCAAGTAAGGTAGAAGTGGTAGAAGTACCATTCCCATCAGACGAAGGTAAGCCAGCTCTTGA  
GTACCTTGTAACGGGTTTGTCAGTATTCAACAATAAAGACGACAAGAAAGTCGCTGCATCTAAGAAATT  
CATCCAGTTTATCGCAGATGACAAGGAGTGGGGACCTAAAGACGTAGTTTCGTACAGGTGCTTTCCAGT  
CCGTACTTCATTTGGAACCTTTATGAAGACAAACGCATGGAACAATCAGCGGCTGGACTCAATACTA  
CTCACCATACTACAACACTATTGATGGATTTGCTGAAATGAGAACACTTTGGTTCCCAATGTTGCAATC  
TGTATCAAATGGTGACGAAAAACCAGCAGATGCTTTGAAAGCCTTCACTGAAAAAGCGAACGAAACAAT  
CAAAAAAGCTATGAAACAA

Table 1

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**SP016 amino acid (SEQ ID NO:26)**

GNSGGSKDAAKSGGDGAKTEITWWAFPVFTQEKTDGVDGTYEKSIIIEAFEKANPDIKVKLETIDFKSGP  
EKITTAIEAGTAPDVLFDAPGRIIQYGKNGKLAELNDLFTDEFVKDVNNENIVQASKAGDKAYMPISS  
APFYMAMNKKMLEADAGVANLVKEGWTTDDFEKVLKALKDKGYTPGSLFSSGQGGDQGTRAFISNLYSGS  
VTDEKVS KYTTDDPKFVKGLEKATSWIKDNLINNGSQFDGGADIQNFANGQTSYTI LWAPAQNGIQAKL  
LEASKVEVVEVPFSPSDEGKPALEYLVNGFAVFNKDDKKVAASKKFIQFIADDEKWEKPKDVVRTGAFPV  
RTSFGKLYEDKRMETISGWTQYYSPYYNTIDGFAEMRTLWFPMLQSVSNGDEKPADALKAFTEKANETI  
KKAMKQ

**SP017 nucleotide (SEQ ID NO:27)**

TTCACAAGAAAAACAAAAATGAAGATGGAGAACTAAGACAGAACAGACAGCCAAAGCTGATGGAAC  
AGTCGGTAGTAAGTCTCAAGGAGCTGCCCAGAAGAAAGCAGAAGTGGTCAATAAAGGTGATTACTACAG  
CATTCAAGGGAAATACGATGAAATCATCGTAGCCAACAAACACTATCCATTGTCTAAAGACTATAATCC  
AGGGGAAAATCCAACAGCCAAGGCAGAGTTGGTCAAACCTCATCAAAGCGATGCAAGAGGCAGGTTTCCC  
TATTAGTGATCATTACAGTGGTTTTAGAA GTTATGAACTCAGACCAAGCTCTATCAAGATTATGTCAA  
CCAAGATGGAAGGCAGCAGCTGACCGTTACTCTGCCCGTCTGGCTATAGCGAACACCAGACAGGCTT  
GGCCTTTGATGTGATTGGGACTGATGGTGATTGGTGACAGAAGAAAAAGCAGCCCAATGGCTCTTGGA  
TCATGCAGCTGATTATGGCTTTGTTGTCCGTATCTCAAAGGCAAGGAAAAGGAAACAGGCTATATGGC  
TGAAGAATGGCACCTGCGTTATGTAGGAAAAGAAGCTAAAGAAATTGCTGCAAGTGGTCTCAGTTTGA  
AGAATACTATGGCTTTGAAGGCGGAGACTACGTCGAT

**SP017 amino acid (SEQ ID NO:28)**

SQEKTKNEDGETKTEQTAKADGTVGSKSQGAAQKAEVVNKGDYYSIQGKYDEIIVANKHYPLSKDYNP  
GENPTAKAELVKLIKAMQEAGFPI SDHYSGRFSYETQTKLYQDYVNQDGKAAADRY SARPGYSEHQ TGL  
AFDVI GTDGLVTEEKAAQWLLDHAADYG FVVRYLKGKEKETGYMAEEWHLRYVGKEAKEIAASGLSLE  
EYGFEGGDYVD

**SP019 nucleotide (SEQ ID NO:29)**

GAAAGGTCTGTGGTCAAATAATCTTACCTGCGGTTATGATGAAAAATAATCTTGGAATAATAATAT  
AAAAATACCTGAAGAAAAATATCAGTTATTATTGGGTCAAATGGTTGTGGGAAATCAACACTCATTAA  
AACCTTGTCTCGACTTATAAAGCCATTAGAGGGAGAAGTATTGCTTGATAATAAATCAATTAATTCTTA  
TAAAGAAAAAGATTTAGCAAAACACATAGCTATATTACCTCAATCTCCAATAATCCCTGAATCAATAAC  
AGTAGCTGATCTTGTAAGCCGTGGTCTGTTCCCTACAGAAAGCCTTTTAAGAGTCTTGGAAGATGA  
CCTTGAAATAATAACAGATCAATGGTTAAGGCCAATGTTGAAGATCTAGCAAATAACCTAGTTGAAGA  
ACTTTCTGGGGGTCAAAGGCAAAGAGTATGGATAGCTCTAGCCCTAGCCCAAGATACAAGTATCCTACT  
TTTAGATGAGCCAACTACTTACTTGGATATCTCATATCAAATAGAACTATTAGACCTCTTGACTGATCT  
AAACCAAAAATATAAGACAACCATTTGCATGATTTGTCAGATATAAATCTAACAGCAAGATACGCTGA  
TTACCTATTTGCAATTAAGAAGGTAAACTTGTGTCAGAGGGAAAGCCTGAAGATATACTAAATGATAA  
ACTAGTTAAAGATATCTTTAATCTTGAAGCAAAAATTATACGTGACCCTATTTCCAATTGCGCTCTAAT  
GATTCCTATTGGCAAGCACCATTGTTAACTCT

**SP019 amino acid (SEQ ID NO:30)**

KGLWSNNLTGCGYDEKIILENINIKIPEEKISVIIGSNCGKSTLIKTL SRLIKPLEGEVLLDNKSINSY  
KEKDLAKHIAILPQSP IIPESITVADLVSRGRFPYRKPFKSLGKDDLEIINRSMVKANVEDLANNLVEE  
LSGGQRQRVWIALALAQDTSILLLDEPTTYLDISYQIELLDLLDLNQQYKTTICMILHDINLTARYAD  
YLFAIKEGKLV AEGKPEDILNDKLVKDI FNLEAKIIRDPI SN SPLMIPIGKHVS

**SP020 nucleotide (SEQ ID NO:31)**

AAACTCAGAAAAGAAAGCAGACAATGCAACAACCTATCAAAATCGCAACTGTTAACCGTAGCGGTTCTGA  
AGAAAAACGTTGGGACAAAAATCCAAGAATTGGTTAAAAAAGACGGAATTACCTTGGAATTTACAGAGTT  
CACAGACTACTCACAACCAAAACAAAGCAACTGCTGATGGCGAAGTAGATTTGAACGCTTTCCAACACTA  
TAACCTCTTGAACTGGAACAAAGAAAAACGGAAAAGACCTTG TAGCGATTGCAGATACTTACATCTC  
TCCAATCCGCTTTACTCAGGTTGAATGGAAGTGCCAACAAGTACACTAAAGTAGAAGACATCCCAGC  
AAACGGAGAAATCGCTGTACCGAATGACGCTACAAACGAAAGCCGTGCGCTTTATTTGCTTCAATCAGC  
TGGCTTGATTAAATTGGATGTTTCTGGAAGTGTCTTGTCAACAGTTGCCAACATCAAAGAAAATCCAAA  
GAACCTGAAAATCACTGAATTGGACGCTAGCCAAACAGCTCGTTCAATTGTCATCAGTTGACGCTGCCGT  
TGTAACAATACCTTCGTTACAGAAGCAAAAATTGGACTACAAGAAATCACTTTTCAAAGAACAAAGCTGA  
TGAAAACCTCAAAACAATGGTACAACATCATTGTTGCAAAAAAGATTGGGAAACATCACCTAAGGCTGA

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Table 1

TGCTATCAAGAAAGTAATCGCAGCTTACCACACAGATGACGTGAAAAAAGTTATCGAAGAATCATCAGA  
TGGTTTGGATCAACCAGTTTGG

**SP020 amino acid (SEQ ID NO:32)**

NSEKKADNATTIKIATVNRSGSEEKRWDKIQELVKKDGITLEFTEFTDYSQPNKATADGEVDLNAFQHY  
NFLNNWNKENGKDLVAIADTYISPIRLYSGLNGSANKYTKVEDIPANGEIAPNDATNESRALYLLQSA  
GLIKLDVSGTALATVANIKENPKNLKITELDASQTARSLSSVDAAVVNNTFVTEAKLDYKKSFLKEQAD  
ENSKQWYNIIVAKKDWETSPKADAIAKKVIAAYHTDDVKKVIEESSDGLDQPVW

**SP021 nucleotide (SEQ ID NO:33)**

TTCGAAAGGGTCAGAAGGTGCAGACCTTATCAGCATGAAAGGGGATGTCATTACAGAACATCAATTTTA  
TGAGCAAGTGAAAAGCAACCCCTTCAGCCCAACAAGTCTTGTTAAATATGACCATCCAAAAAGTTTGTGA  
AAAACAATATGGCTCAGAGCTTGATGATAAAGAGGTTGATGATACTATTGCCGAAGAAAAAACAATA  
TGGCGAAAACCTACCAACGTGTCTTGTCACAAGCAGGTATGACTCTTGAAACACGTAAAGCTCAAATTCG  
TACAAGTAAATTAGTTGAGTTGGCAGTTAAGAAGGTAGCAGAAGCTGAATTGACAGATGAAGCCTATAA  
GAAAGCCTTTGATGAGTACACTCCAGATGTAACGGCTCAAATCATCCGTCTTAATAATGAAGATAAGGC  
CAAAGAAGTTCTCGAAAAGCCAAGGCAGAAGGTGCTGATTTTGCTCAATTAGCCAAAGATAATTCAAC  
TGATGAAAAACAAAAGAAAATGGTGGAGAAATTACCTTTGATTCTGCTTCAACAGAAGTACCTGGAGC  
AAGTCCAAAAAAGCCGCTTTTCGCTTTTAGATGTGGGATGGTGTCTTCTGGATGTGGATTACAGCAACTG  
GGGCACACCAAGCCTACAG

**SP021 amino acid (SEQ ID NO:34)**

SKGSEGADLISMKGDVITEHQFYEQVKSNSPAQQVLLNMTIQKVFQYGSSELDDEKVDVTIAEKKQY  
GENYQRVLSQAGMTLETRKAQIRTSKLVELAVKKVAEAEALTDEAYKKAFDEYTPDVTAQIIIRLNEDKA  
KEVLEKAKAEGADFAQLAKDNSTDEKTKENGGEITFDSASTEVPGASPKKPLFAFRCGMVFLDVDYSNW  
GTPSLQ

**SP022 nucleotide (SEQ ID NO:35)**

GGGGATGGCAGCTTTTAAAAATCCTAACAATCAATACAAAGCTATTACAATTGCTCAAACCTCTAGGTGA  
TGATGCTTCTTCAGAGGAATTGGCTGGTAGATATGGTTCTGCTGTTCAAGTGTACAGAAGTGAAGTGCCTC  
AAACCTTTCAACAGTTAAAACTAAAGCTACGGTTGTAGAAAAACCACTGAAAGATTTTAGAGCGTCTAC  
GTCTGATCAGTCTGGTTGGGTGGAATCTAATGGTAAATGGTATTTCTATGAGTCTGGTGTATGTGAAGAC  
AGGTTGGGTGAAAACAGATGGTAAATGGTACTATTTGAATGACTTAGGTGTATGCAGACTGGATTTGT  
AAAATTTTCTGGTAGCTGGTATTACTTTAGCAATTCAGGTGCTATGTTTACAGGCTGGGGAACAGATGG  
TAGCAGATGGTTCTACTTTGACGGCTCAGGAGCTATGAAGACAGGCTGGTACAAGGAAAATGGCACTTG  
GTATTACCTTGACGAAGCAGGTATCATGAAGACAGGTTGGTTTAAAGTCGGACCACACTGGTACTATGC  
CTACGGTTACAGGAGCTTTGGCTGTGAGCACAACAACACCAGATGGTTACCGTGTAATGGTAAATGGTGA  
ATGGGTAAAC

**SP022 amino acid (SEQ ID NO:36)**

GMAAFKNPNNQYKAITIAQTLGDDASSEELAGRYGSAVQCTEVTASNLSVTKTKATVVEKPLKDFRST  
SDQSGWVESNGKWYFYESGDVKTGWVKTDGKWYLLNDLGMVQTGFVKFSGSWYLLNSNGAMFTGWGTDG  
SRWFYFDGSGAMKTGWYKENGWYLLDEAGIMKTGWFKVGPWHYYAYGSGALAVSTTTPDGYRVNNGE  
WVN

**SP023 nucleotide (SEQ ID NO:37)**

AGACGAGCAAAAAATTAAGCAAGCAGAAGCGGAAGTTGAGAGTAAACAAGCTGAGGCTACAAGGTAAAA  
AAAAATCAAGACAGATCGTGAAAGAAGCAGAAGAAGAAGCTAAACGAAGAGCAGATGCTAAAGAGCAAGG  
TAAACCAAAGGGGCGGGCAAAACGAGGAGTTCCTGGAGAGCTAGCAACACCTGATAAAAAAGAAAATGA  
TGCGAAGTCTTCAGATTCTAGCGTAGGTGAAGAACTCTTCCAAGCCCATCCCTGAAACCAGAAAAA  
GGTAGCAGAAGCTGAGAAGAAGGTTGAAGAAGCTAAGAAAAAGCCGAGGATCAAAAAGAAGAAGATCG  
CCGTAAC TACCAACCAATACTTACAAAACGCTTGAAC TTGAAATTGCTGAGTCCGATGTGGAAGTTAA  
AAAAGCGGAGCTTGAAC TAGTAAAAGAGGAAGCTAAGGAACCTCGAAACGAGGAAAAAGTTAAGCAAGC  
AAAAGCGGAAGTTGAGAGTAAAAAGCTGAGGCTACAAGGTTAGAAAAATCAAGACAGATCGTAAAAA  
AGCAGAAGAAGAAGCTAAACGAAAAGCAGCAGAAGAAGATAAAGTTAAAGAAAAACCAGCTGAACAACC  
ACAACCAGCGCCGGCTCCAAAAGCAGAAAAACCAGCTCCAGCTCCAAAACCAGAGAATCCAGCTGAACA  
ACCAAAAGCAGAAAAACCAGCTGATCAACAAGCTGAAGAAGACTATGCTCGTAGATCAGAAGAAGAATA  
TAATCGCTTGACTCAACAGCAACCGCCAAAAACTGAAAAACCAGCACAACCATCTACTCCAAAAACAGG

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Table 1

CTGGAAACAAGAAAACGGTATGTGGTACTTCTACAATACTGATGGTTCAATGGCGACAGGATGGCTCCA  
AAACAATGGCTCATGGTACTACCTCAACAGCAATGGCGCTATGGCGACAGGATGGCTCCAAAACAATGG  
TTCATGGTACTATCTAAACGCTAATGGTTCAATGGCAACAGGATGGCTCCAAAACAATGGTTTCATGGTA  
CTACCTAAACGCTAATGGTTCAATGGCGACAGGATGGCTCCAATACAATGGCTCATGGTACTACCTAAA  
CGCTAATGGTTCAATGGCGACAGGATGGCTCCAATACAATGGCTCATGGTACTACCTAAACGCTAATGG  
TGATATGGCGACAGGTTGGGTGAAAGATGGAGATACCTGGTACTATCTTGAAGCATCAGGTGCTATGAA  
AGCAAGCCAATGGTTCAAAGTATCAGATAAATGGTACTATGTCAATGGCTCAGGTGCCCTTGCAGTCAA  
CACAACTGTAGATGGCTATGGAGTCAATGCCAATGGTGAATGGGTAAAC

**SP023 amino acid (SEQ ID NO:38)**

DEQKIKQAEAEVESKQAEATRLKKIKTDREEAEAEAKRRADAKEQKPKGRAKRGVPGELATPDKKEND  
AKSSDSSVGEETLPSPLKPEKKVAEAEKKVEEAKKKAEDQKEEDRRNYPNTYKLTLELEIAESDVEVK  
KAELVLVKEEAKPRNEEKVKQAKAEVESKKAETRLEKIKTDRKKAEEEEAKRKAEEEDKVKEKPAEQP  
QPAPAPKAEKPAPAPKPPENPAEQPKAEKPADQQAEEEDYARRSEEEYNRLTQQQPPKTEKPAQPSTPKTG  
WKQENGMWYFYNTDGSMATGWLQNNGSWYYLNSNGAMATGWLQNNGSWYYLNANGSMATGWLQNNGSWY  
YLNANGSMATGWLQYNGSWYYLNANGSMATGWLQYNGSWYYLNANGDMATGWVKDGTWYYLEASGAMK  
ASQWFKVSDKWYYVNGSGALAVNTTVDGYGVNANGEWVN

**SP025 nucleotide (SEQ ID NO:39)**

CTGTGGTGAGGAAGAACTAAAAAGACTCAAGCAGCACAAACAGCCAAAACAACAAACGACTGTACAACA  
AATTGCTGTTGGAAAAGATGCTCCAGACTTCACATTGCAATCCATGGATGGCAAAGAAGTTAAGTTATC  
TGATTTTAAAGGTAAGGTTTACTTGAAGTTTGGGCTTCATGGTGTGGTCCATGCAAGAAAAGTAT  
GCCAGAGTTGATGGAAC TAGCGGCGAAACCAGATCGTGATTTGAAAATCTTACTGTCATTGCACCAGG  
AATTCAAGGTGAAAAAAGTGTGAGCAATTCCACAATGGTTCCAGGAACAAGGATATAAGGATATCCC  
AGTCTTTATGATACCAAAGCAACCACTTCCAAGCTTATCAAAATCGAAGCATTCCTACAGATATT

**SP025 amino acid (SEQ ID NO:40)**

CGEEETKKTQAAQPKQQTTVQQIAVGKDAPDFTLQSMGKEVKLSDFKGGKVVYLKFWASWCGPCKKSM  
PELMELAAKPD RDFEILT VIAPGIQGEKTVEQFPQWFQEQGYKDI PVL YDTKATTSKL IKFEAFLQNI

**SP028 nucleotide (SEQ ID NO:41)**

GACTTTTAAACAATAAACTATTGAAGAGTTGCACAATCTCCTTGTCTCTAAGGAAATTTCTGCAACAGA  
ATTGACCCAAGCAACACTTGAAAATATCAAGTCTCGTGAGGAAGCCCTCAATTCATTTGTACCATCGC  
TGAGGAGCAAGCTCTTGTTCAAGCTAAAGCCATTGATGAAGCTGGAATTGATGCTGACAATGTCCTTTC  
AGGAATTCCTACTTGCTGTTAAGGATAACATCTCTACAGACGGTATTCTCACAACCTGCTGCCTCAAAAAT  
GCTCTACAACCTATGAGCCAATCTTTGATGCGACAGCTGTGTTGCAATGCAAAAACCAAGGGCATGATTGT  
CGTTGGAAAGACCAACATGGACGAATTTGCTATGGGTGGTTCAGGTGAAACTTCACACTACGGAGCAAC  
TAAAAACGCTTGGAACCAACAGCAAGGTTCTGGTGGGTTCATCAAGTGGTTCGCGCAGCTGTAGCCTC  
AGGACAAGTTGCTTGTCACTTGGTTCTGATACTGGTGGTTCATCCGCCAACCTGCTGCCTTCAACGG  
AATCGTTGGTCTCAAACCAACCTACGGAACAGTTTCACGTTTCGGTCTCATTCGCTTTGGTAGCTCATT  
AGACCAGATTGGACCTTTTGCTCCTACTGTTAAGGAAAATGCCCTCTTGCTCAACGCTATTGCCAGCGA  
AGATGCTAAAGACTCTACTTCTGCTCCTGTCCGCATCGCCGACTTTACTTCAAAAATCGGCCAAGACAT  
CAAGGGTATGAAAATCGCTTTGCCTAAGGAATACCTAGGCGAAGGAATTGATCCAGAGGTTAAGGAAAC  
AATCTTAAACGCGGCCAAACACTTTGAAAAATTTGGGTGCTATCGTCAAGAAGTCAGCCTTCCTCACTC  
TAAATACGGTGTGCGGTTTATTACATCATCGCTTCATCAGAAGCTTCATCAAACCTTGCAACGCTTCGA  
CGGTATCCGTTACGGCTATCGCGCAGAAGATGCAACCAACCTTGATGAAATCTATGTAAACAGCCGAAG  
CCAAGGTTTTTGGTGAAGAGGTAAACGTCGTATCATGCTGGGTACTTTTCAGTCTTTTCATCAGGTTACTA  
TGATGCCCTACTACAAAAGGCTGGTCAAGTCCGTACCTCATCATTCAAGATTTGAAAAAGTCTTCGC  
GGATTACGATTTGATTTTGGGTCCAACCTGCTCCAAGTGTGCTTATGACTTGGATTCTCTCAACCATGA  
CCCAGTTGCCATGTACTTAGCCGACCTATTGACCATACTGTAACTTGGCAGGACTGCCTGGAATTTTC  
GATTCCTGCTGGATTCTCTCAAGGTCTACCTGTGCGACTCCAATTGATTGGTCCCAAGTACTCTGAGGA  
AACCATTTACCAAGCTGCTGCTGCTTTTGAAGCAACAACAGACTACCACAAACAACAACCCGTGATTTT  
TGGAGGTGACAAC

**SP028 amino acid (SEQ ID NO:42)**

TFNNKTI EELHNLVSKEISATELTQATLENIKSREEALNSFVTIAEEQALVQAKAIDEAGIDADNVLS  
GIPLAVKDNISTDGILTTAASKMLYNYEPIFDATAVANAKTKGMIVVGKTNMDEFAMGGSGSETSHYGAT  
KNAWNH SKVPGGSSSGSAAVASGQVRLSLGSDTGGSI RQPAFNGIVGLKPTYGTVSRFGLIAFGSSL

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Table 1

DQIGPFAPTIVENALLLNIAISEDADKSTAPVRIADFTSKIGQDIKGMKIALPKEYLGEGIDPEVKET  
ILNAAKHFEKLGAIVEEVSLPHSKYGVAVVYIIASSEASSNLQRFDGIRYGYRAEDATNLDEIYVNSRS  
QGFGEVKKRRIMLGTFSLSGGYDAYKKAGQVRLIIQDFEKFVADYDLILGPTAPSVAYDLDSLNDH  
PVAMYLADLLTIPVNLGLPGISIPAGFSQGLPVGLQLIGPKYSEETIYQAAAFEATTDYHKQQPVI  
GGDN

**SP030 nucleotide (SEQ ID NO:43)**

CTTTACAGGTAAACAACACTACAAGTCGGCGACAAGGCGCTTGATTTTTCTCTTACTACAACAGATCTTTC  
TAAAAATCTCTGGCTGATTTTGTATGGCAAGAAAAAGTCTTGAGTGTCTGTTCTCTTATCGATACAGG  
CATCTGCTCAACTCAAACACGTCGTTTTAATGAAGAATTGGCTGGACTGGACAACACGGTCGTATTGAC  
TGTTTTCAATGGACCTACCTTTTGTCTCAAAAACGTTGGTGGCGGTGCTGAAGGCCTTGACAATGCCATTAT  
GCTTTTCAGACTACTTTGACCATTCTTTTCGGGCGCGATTATGCCCTCTTGATCAACGAATGGCACCTATT  
AGCACGCGCAGTCTTTGTCCTCGATACTGACAATACGATTTCGCTACGTTGAATACGTGGATAATATCAA  
TTCTGAGCCAACTTCGAA

**SP030 amino acid (SEQ ID NO:44)**

FTGKQLQVGDKALDFSLTTTDLSSKSLADFDGKKKVLVSVPSIDTGICSTQTRRFNEELAGLDNTVVL  
VSMDFPFAQKRWCGAEGLDNAIMLSDFDHSFGRDYALLINEWHLLARAVFVLDNTIRYVEYVDNIN  
SEPNFE

**SP031 nucleotide (SEQ ID NO:45)**

CCAGGCTGATACAAGTATCGCAGACATTCAAAAAAGAGGCGAACTGGTTGTCGGTGTCAAACAAGACGT  
TCCCAATTTTGGTTACAAGATCCCAAGACCGGTACTTATTCTGGTATCGAAACCGACTTGGCCAAGAT  
GGTAGCTGATGAAGTCAAGGTCAAGATTTCGCTATGTGCCGGTTACAGCACAAACCCGGGCCCCCTTCT  
AGACAATGAACAGGTCGATATGGATATCGCGACCTTTACCATCACGGACGAACGCAAAAACTCTACAA  
CTTTACCAGTCCCTACTACACAGACGCTTCTGGATTTTGGTCAATAAATCTGCCAAAATCAAAAAGAT  
TGAGGACCTAAACGGCAAAACCATCGGAGTCGCCAAGGTTCTATCACCAACGCCTGATTACTGAACT  
GGGTAAAAAGAAAGGTCTGAAGTTTAAATTCGTGAACTTGGTTCCTACCCAGAATTGATTACTTCCCT  
GCACGCTCATCTGATCGATCACTTTTCCGTTGACCGCTCTATTCTATCTGGCTACACTGATAACCGGAC  
AGCAGTACTAGATGATAGTTTCAAGCCATCTGACTACGGTATTGTTACCAAGAAATCAATACAGAGCT  
CAACGACTATCTTGATAACTTGGTTACTAAATGGAGCAAGGATGGTAGTTTGCAGAACTTTATGACCG  
TTACAAGCTCAAACCATCTAGCCATACTGCAGAT

**SP031 amino acid (SEQ ID NO:46)**

QADTSIADIQKRGELVVGKQDVPNFGYXDPKGTYSIGIETDLAKMVADELKVKIRYVPVTAQTRGPLL  
DNEQVMDIATFTITDERKKLYNFTSPYYTDASGFLVNSAKIKKIEDLNGKTIGVAQGSITQRLITEL  
GKKKGLKFKFVELGSYPELITSLHAHRIDTF SVDRSILSGYTSKRTALLDDSFKPSDYGIVTKKSNT  
NDYLDNLVTKWSKDGSLQKLYDRYKLPSSHTAD

**SP032 nucleotide (SEQ ID NO:47)**

GTCTGTATCATTGAAAACAAAGAAACAAACCGTGGTGTCTTgACTTTCACTATCTCTCAAGACCAAAT  
CAAACCAGAATTGGACCGTGTCTTCAAGtCAGTGAAGAAATCTCTTAATGTTCCAGGTTTCCGTAAAGG  
TCACCTTCCACGCCCTATCTTCGACCAAAAAATTGGTGAAGAAGCTCTTTATCAAGATGCAATGAACGC  
ACTTTTGCCAAACGCTTATGAAGCAGCTGTAAAAGAAGCTGGTCTTGAAGTGGTTGCCCAACCAAAAT  
TGACGTAACCTCAATGGAAAAAGGTCAAGACTGGGTATCACTGCTGAAGTCGTTACAAAACCTGAAGT  
AAAATTGGGTGACTACAAAACCTTGAAGTATCACTTGATGTAGAAAAAGAAGTAAGTACGCTGATGT  
CGAAGAGCGTATCGAACGCGAACGCAACCAACCTGGCTGAATTGGTTATCAAGGAAGCTGCTGCTGAAAA  
CGGCGACACTGTTGTGATCGACTTTCGTTGGTTCTATCGACGGTGTGAAATTGACGGTGGAAAAGGTGA  
AAACTTCTCACTTGGACTTGGTTCAAGTCAATTCATCCCTGGTTTTCGAAGACCAATTGGTAGGTCACTC  
AGCTGGCGAAACCGTTGATGTTATCGTAACATTCACGAGAAGCTACCAAGCAGAAGACCTTGCAGGTAA  
AGAAGCTAAATTCTGTGACAACATCCACGAAGTAAAAGCTAAAGAAGTTCCGGCTCTTGACGATGAACT  
TGCAAAAGACATTGATGAAGAAGTTGAAACACTTGCTGACTTGAAAGAAAAATACAGCAAAGAATTGGC  
TGCTGCTAAAGAAGAAGCTTACAAAGATGCAGTTGAAGGTGCAGCAATTGATACAGCTGTAGAAAATGC  
TGAAATCGTAGAACTTCCAGAAGAAATGATCCATGAAGAAGTTACCGTTTCAGTAAATGAATTCCTTGG  
GAATTTGCAACGTCAAGGGATCAACCTGACATGTACTTCCAAATCACTGGAAGTACTCAAGAAGACCT  
TCACAACCAATACCAAGCAGAAGCTGAGTCACGTACTAAGACTAACCTTGTTATCGAAGCAGTTGCCAA  
AGCTGAAGGATTTGATGCTTCAGAAGAAGAAATCCAAAAGAAGTTGAGCAATTGGCAGCAGACTACAA

Table 1

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CATGGAAGTTGCACAAGTTCAAACTTGCTTTCAGCTGACATGTTGAAACATGATATCACTATCAAAAA  
AGCTGTTGAATTGATCACAAGCACAGCAACAGTAAAA

**SP032 amino acid (SEQ ID NO:48)**

SVSFENKETNRGVLTFITISQDQIKPELDRVFKSVKSLNVPGRKGLPRPIFDQKFGEEALYQDAMNA  
LLPNAYEAAVKEAGLEVVAQPKIDVTSMEKGQDWVITAEVVKPEVKLGDKNLEVSVDVEKEVTDADV  
EERIERERNLAEVLKEAAAENGDTVVIDFVGSIDGVEFDGGKGENFSLGLGSGQFIPGFEDQLVGH  
AGETVDVIVTFPEDYQAEDLAGKEAKFVTTIHEVKAKEVPALDDELAKDIDEEVETLADLKEKYSKELA  
AAKEEAYKDAVEGAAIDTAVENAEIVELPEEMIHEEVHRSVNEFLGNLQRQGINPDYFQITGTTQEDL  
HNQYQAEASRTKTNLVIEAVAKAEGFDASEEEIQKEVEQLAADYNMEVAQVQNLLSADMLKHDITIKK  
AVELITSTATVK

**SP033 nucleotide (SEQ ID NO:49)**

TGGTCAAAAGGAAAGTCAGACAGGAAAGGGGATGAAAATTGTGACCAGTTTTTATCCTATCTACGCTAT  
GGTTAAGGAAGTATCTGGTGACTTGAATGATGTTCCGGATGATTCAGTCAAGTAGTGGTATTCCTCCTT  
TGAACCTTCGGCAAATGATATCGCAGCCATCTATGATGCAGATGTCTTTGTTTACCATTCTCATACT  
CGAATCTTGGGCAGGAAGTCTGGATCCAAATCTAAAAAATCCAAAGTGAAGGTCTTAGAGGCTTCTGA  
GGGAATGACCTTGAACGTGTCCCTGGACTAGAGGATGTGGAAGCAGGGGATGGAGTTGATGAAAAAC  
GCTCTATGACCCTCACACATGGCTAGATCCTGAAAAAGCTGGAGAAGAAGCCCAAATTATCGCTGATAA  
ACTTTTCAGAGGTGGATAGTGAGCATAAAGAGACTTATCAAAAAATGCGCAACCTTTATCAAAAAAGCT  
CAGGAAT

**SP033 amino acid (SEQ ID NO:50)**

GQKESQTGKGMKIVTSFYPIYAMVKEVSGDLNDVRMIQSSSGIHSFEPSSANDIAAIYDADVIFYHSHTL  
ESWAGSLDPNLKKSQVLEASEGMLTLPVGLDVEAGDGVDEKTLYPDHTWLDPEKAGEEAQIIADK  
LSEVDSEHKETYQKNAQPLSKLRN

**SP034 nucleotide (SEQ ID NO:51)**

GAAGGATAGATATATTTTAGCATTTGAGACATCCTGTGATGAGACCAGTGTGCCCGTCTTGAAAAACGA  
CGATGAGCTCTTGTCCAATGTCATTGCTAGTCAAATGAGAGTCACAAACGTTTTGGTGGCGTAGTGCC  
CGAAGTAGCCAGTCGTCACCATGTGAGGTCATTACAGCCTGTATCGAGGAGGCATTGGCAGAAGCAGG  
GATTACCGAAGAGGACGTGACAGCTGTTGCGGTTACCTACGGACCAGGCTTGGTTCGGAGCCTTGCTAGT  
TGGTTTGTGAGCTGCCAAGGCCTTTGCTTGGGCTCACGGACTTCCACTGATTCTGTAAATCACATGGC  
TGGGCACCTCATGGCAGCTCAGAGTGTGGAGCCTTTGGAGTTTCCCTTGCTAGCCCTCTTGGTACGCG  
CGGACACACAGAGTTGGTTTATGTTTTCGGAGGCAGGAGATTATAAGATTGTTGGGGAAACCCGTGATGA  
TGCGGTTGGTGAGGCTTATGATAAGGTCGGCCGTGTCATGGGCTTGACCTATCCTGCAGGTCTGTGAGAT  
TGACGAGCTGGCTCATCAGGGGCAGGATATTTATGATTTCCCCCGTGCCATGATTAAGGAAGATAATCT  
GGAGTTCTCCTTCTCAGGTTTGAAATCTGCCTTTATCAATCTTCATCACAATGCCGAGCAAAAGGGAGA  
AAGCCTGTCTACAGAAGATTTGTGTGCTTCCTTCCAAGCAGCAGTTATGGACATTCTCATGGCAAAAC  
CAAGAAGGCTTTGGAGAAATATCCTGTTAAATCCTAGTTGTGGCAGGTGGTGTGGCAGCCAATAAAGG  
TCTCAGAGAACGCCTAGCAGCCGAAATCACAGATGTCAAGGTTATCATCCCCCTCTGCGACTCTGCGG  
AGACAATGCAGGTATGATTGCCTATGCCAGCGTCAGCNAAGTGAACAAAGAAAACCTTCGAGGCTGGGA  
CCTCAATGCCAAACCAAGTCTTGCTTTGATACCATGGAA

**SP034 amino acid (SEQ ID NO:52)**

KDRYLAFETSCDETSVAVLKNDELLSNVIASQIESHKRFGGVPEVASRHHVEVITACIEEALAEAG  
ITEEDVTAVAVTYGPGLVGALLVGLSAAKAFWAHGLPLIPVNHMAGHLMQAQSVLEPLFLLALLVSG  
GHTELIVYVSEAGDYKIVGETRDDAVGEAYDKVGRVMGLTYPAGREIDELAHQGDIDYDFPRAMIKEDNL  
EFSFSGLSAFINLHHNAEQKGESLSTEDLCASFQAAMVDILMAKTKKALEKYPVKILVVAGGVAANKG  
LRERLAAEITDVKVIIPPLRLCGDNAGMIAYASVSXWNKENFAGWDLNAKPSLAFDTME

**SP035 nucleotide (SEQ ID NO:53)**

GGTAGTTAAAGTTGGTATTAACGGTTTCGGACGTATCGGTCGTCTTGCTTTCCGTCGTATCCAAAACGT  
AGAAGGTGTTGAAGTTACACGCATCAACGACCTTACAGATCCAGTTATGCTTGCACACTTGTTGAAATA  
CGACACAACCTCAAGGTCGTTTCGACGGTACTGTTGAAGTTAAAGAAGGTGGATTTGAAGTTAACGGTAA  
ATTCATCAAAGTTTCTGCTGAACGTGATCCAGAACAATCGACTGGGCTACTGACGGTGTAGAAATCGT  
TCTTGAAGCTACTGGTTTCTTTGCTAAGAAAGAAGCAGCTGAAAAACACCTTAAAGGTGGAGCTAAAAA

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Table 1

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AGTTGTTATCACTGCTCCTGGTGGAACGACGTTAAAAACAGTTGTATTCAACACTAACCACGACGTTCT  
TGACGGTACTGAAACAGTTATCTCAGGTGCTTCATGTACTACAACTGCTTGGCTCCAATGGCTAAAGC  
TCTTCAAGACAACTTTGGTGTTGTTGAAGGATTGATGACTACTATCCACGCTTACACTGGTGACCAAAT  
GATCCTTGACGGACCACACCGTGGTGGTGACCTTCGCCGTGCTCGCGCTGGTGCTGCAAACATCGTTCC  
TAACCTCAACTGGTGCTGCAAAAGCTATCGGTCTTGTAAATCCCAGAATTGAATGGTAAACTTGACGGATC  
TGCACAACGCGTTCCAACCTCCAACCTGGATCAGTTACTGAATTGGTAGCAGTTCTTGAAGAAGACGTTAC  
TGTTGATGAAGTGAACGCAGCTATGAAAGCAGCTTCAAACGAATCATACGGTTACACAGAAGATCCAAT  
CGTATCTTCAGATATCGTAGGTATGTCTTACGGTTCATTGTTTGACGCAACTCAAACATAAGTTCTTGA  
CGTTGACGGTAAACAATTGGTTAAAGTTGTATCATGGTACGACAACGAAATGTCATACACTGCACAAC  
TGTTTCGTACTCTTGAATACTTCGCAAAAATTGC

**SP035 amino acid (SEQ ID NO:54)**

VVKVGINGFGRIGRLAFRIQNVGEVETRINDLTDPMVLAHLLKYDTTQGRFDGTVEVKEGGFEVNGK  
FIKVS AERDPEQIDWATDGV EIVLEATGFFAKKEAAEKHLKGGAKKVITAPGGNDVKTVVFNTNHDVL  
DGTETVISGASCTTNCLAPMAKALQDNFVGVEGLMTTIHAYTGDOMILDGPHRGDLRRRAGAANIVP  
NSTGAAKAIGLVIPELNGKLDGSAQRVPTPTGSVTELVAVLEKNVTVDEVNAAMKAASNESYGYTEDPI  
VSSDIVGMSYGS LFDATQTKVLDVDGKQLVKVVS WYDNEMS YTAQLVRTLGLRKNC

**SP036 nucleotide (SEQ ID NO:55)**

TTCTTACGAGTTGGGACTGTATCAAGCTAGAACGGTTAAGGAAAATAATCGTGTTTCCTATATAGATGG  
AAAACAAGCGACGCAAAAACGGAGAATTTGACTCCTGATGAGGTTAGCAAGCGTGAAGGAATCAATGC  
TGAGCAAATCGTCATCAAGATAACAGACCAAGGCTATGTCACTTCACATGGCGACCACTATCATTATTA  
CAATGGTAAGGTTCCCTATGACGCTATCATCAGTGAAGAATTACTCATGAAAGATCCAAACTATAAGCT  
AAAAGATGAGGATATTGTTAATGAGGTCAAGGGTGGATATGTTATCAAGGTAGATGGAAAATACTATGT  
TTACCTTAAGGATGCTGCCCACGCGGATAACGTCCGTACAAAAGAGGAAATCAATCGACAAAAACAAGA  
GCATAGTCAACATCGTGAAGGTGGAACCTCAAGAAACGATGGTGCTGTTGCGCTTGGCACGTTTCGCAAGG  
ACGCTATACTACAGATGATGGTTATATCTTTAATGCTTCTGATATCATAGAGGATACTGGTGATGCTTA  
TATCGTTCCCTCATGGAGATCATTACCATTACATTCCTAAGAATGAGTTATCAGCTAGCGAGTTGGCTGC  
TGCAGAAGCCTTCCTATCTGGTCGAGGAAATCTGTCAAATTCAGAACCCTATCGCCGACAAAATAGCGA  
TAACACTTCAAGAACAACACTGGGTACCTTCTGTAAGCAATCCAGGAACCTACAAATACTAACACAAGCAA  
CAACAGCAACACTAACAGTCAAGCAAGTCAAAGTAATGACATTGATAGTCTCTTGAAACAGCTCTACAA  
ACTGCTTGTGAGTCAACGACATGTAGAATCTGATGGCTTGTCTTTGATCCAGCACAAATCACAAGTCG  
AACAGCTAGAGGTGTTGCGAGTGCCACACGGAGATCATTACCACTTCATCCCTTACTCTCAAATGTCTGA  
ATTGGAAGAACGAATCGCTCGTATTATTCCCCTTCGTTATCGTTCAAACCATTGGGTACCAGATTCAAG  
GCCAGAACAACCAAGTCCACAACCGACTCCGGAACCTAGTCCAGGCCCGCAACCTGCACCAAATCTTAA  
AATAGACTCAAATCTTCTTTGGTTAGTCAGCTGGTACGAAAAGTTGGGGAAGGATATGTATTGGAAGA  
AAAGGGCATCTCTCGTTATGTCTTTGCGAAAGATTTACCATCTGAAACTGTTAAAAATCTTGAAAGCAA  
GTTATCAAAACAAGAGAGTGTTCACACACTTTAACTGCTAAAAAAGAAAATGTTGCTCCTCGTGACCA  
AGAATTTTATGATAAAGCATATAATCTGTTAACTGAGGCTCATAAAGCCTTGTGTTGNAATAAGGGTCG  
TAATTCGTGATTTCCAAGCCTTAGACAAATTATTAGAACGCTTGAATGATGAATCGACTAATAAAGAAAA  
ATTGGTAGATGATTTATTGGCATTCTTAGCACCAATTACCCATCCAGAGCGACTTGGCAAACCAAATTC  
TCAAATTGAGTATACTGAAGACGAAGTTTCGTATTGCTCAATTAGCTGATAAGTATACAACGTCAGATGG  
TTACATTTTGTATGAACATGATATAATCAGTGATGAAGGAGATGCATATGTAACGCCTCATATGGGCCA  
TAGTCACTGGATTGGAAAAGATAGCCTTTCTGATAAGGAAAAAGTTGCAGCTCAAGCCTATACTAAAGA  
AAAAGGTATCCTACCTCCATCTCCAGACGCAGATGTTAAAGCAAATCCAACCTGGAGATAGTGCAGCAGC  
TATTTACAATCGTGTGAAAGGGGAAAAACGAATTCACCTCGTTCGACTTCCATATATGGTTGAGCATAC  
AGTTGAGGTTAAAAACGGTAATTTGATTATTCCTCATAAGGATCATTACCATAATATAAATTTGCTTG  
GTTTGATGATCACACATACAAAGCTCCAAATGGCTATACCTTGAAGATTGTTTGGCAGCAGTAAGTA  
CTACGTAGAACACCTTGACGAACGTCCACATTCTAATGATGGATGGGGCAATGCCAGTGAGCATGTGTT  
AGGCAAGAAAGACCACAGTGAAGATCCAAATAAGAACTTCAAAGCGGATGAAGAGCCAGTAGAGGAAAC  
ACCTGCTGAGCCAGAAGTCCCTCAAGTAGAGACTGAAAAAGTAGAAGCCCAACTCAAAGAAGCAGAAGT  
TTTGCTTGCGAAAGTAACGGATTCTAGTCTGAAAGCCAATGCAACAGAACTCTAGCTGGTTTACGAAA  
TAATTTGACTCTTCAAATTATGGATAACAATAGTATCATGGCAGAAGCAGAAAAATTACTTGCCTTGTT  
AAAAGGAAGTAATCCTTCATCTGTAAGTAAGGAAAAAATAAAC

**SP036 amino acid (SEQ ID NO:56)**

SYELGLYQARTVKENNRVSYIDGKQATQKTENLTPDEVSKREGINAEQIVIKITDQGYVTSHGDHYHY  
NGKVPYDAI ISEELLMKDPNYKLKDEDIVNEVKGGYVIKVDGKYVYVLKDAHADNVRTKEEINRQKQE

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Table 1

HSQHREGGTPRNDGAVALARSQGRYTTDDGYIFNASDIIEDTGDAYIVPHGDHYHYIPKNELSASELAA  
AEAFLSGRGNLSNSRTYRRQNSDNTSRTNWVPSVSNP GTTNTNTSNNSTNSQASQSNIDISLLKQLYK  
LPLSQRHVESDGLVFDPAQITSRTARGVAVPHGDHYHFI PYSQMSELEERIARIIP LRYRSNHWVPDSR  
PEQPSPOPTPEPSPGPQPAPNLKIDSNSSLVSQLVRKVGEQYVFEKGISRYVFAKDLPSSETVKNLESK  
LSKQESVSHTLTAKKENVAPRDQEFYDKAYNLLTEAHKALFXNKGRNSDFQALDKLLERLNDESTNKEK  
LVDDLLAFLAPITHPERLGKPN SQIEYTEDEVRIAQLADKYTTSDGYIFDEHDIISDEGDAYVTPHMGH  
SHWIGKDSLSDKEKVAAQAYTKEKGILPPSPDADV KANPTGDSAAAIYNRVKGEKRIPLVRLPYMVEHT  
VEVKNGNLIIPH KDHYHNIKFAWFDDHTYKAPNGYTLEDLFATIKYYVEHPDERPHSNDGWGNASEHVL  
GKKDHSEDPNKNFKADEEPVEETPAEPEVPQVETEKVEAQLKEAEVLLAKVTDSSSLKANATETLAGLRN  
NLTLQIMDNNSIMAEAEKLLALLKGSNPSSVSKEKIN

**SP038 nucleotide (SEQ ID NO:57)**

TACTGAGATGCATCATAATCTAGGAGCTGAAAAGCGTTCAGCAGTGGCTACTACTATCGATAGTTTTAA  
GGAGCGAAGTCAAAAAGTCAGAGCACTATCTGATCCAAATGTGCGT TTTGTTCCCTTCTTTGGCTCTAG  
TGAATGGCTTCGTTTTGACGGTGCTCATTCTGCGGTATTAGCTGAGAAATACAATCGTTCCTACCGTCC  
TTATCTTTTAGGACAGGGGGGAGCTGCATCGCTTAACCAATATTTTGGAAATGCAACAGATGTTACCACA  
GCTGGAGAATAAACAAGTTGTGTATGTTATCTCACCTCAGTGGTTCAGTAAAAATGGCTATGATCCAGC  
AGCCTTCCAGCAGTATTTTAATGGAGACCAGTTGACTAGTTTTCTGAAACATCAATCTGGGGATCAGGC  
TAGTCAATATGCAGCGACTCGCTTACTGCAACAGTTCCCAAACGTAGCTATGAAGGACCTGGTTCAGAA  
GTTGGCAAGTAAAGAAGAATTGTCGACAGCAGACAATGAAATGATTGAATTATTGGCTCGTTTTAATGA  
ACGCCAAGCTTCCTTTTTTGGTCAGTTTTTCGGTTAGAGGCTATGTTAACTACGATAAGCATGTAGCTAA  
GTATTTAAAAATCTTGCCAGACCAGTTTTCTTATCAGGCAATAGAAGATGTTGTCAAAGCAGATGCTGA  
AAAAAATACTTCCAATAATGAGATGGGAATGGAAAATTTATTTCTATAATGAGCAGATCAAGAAGGATTT  
GAAGAAATTAAAGGATTCTCAGAAAAGCTTTACCTATCTCAAGTCGCCAGAGTATAATGNNTTGCAGTT  
GGTTTTAACACAGTTTTCTAAATCTAAGGTAAACCCGATTTTTATCATTCCACCTGTTAATAAAAAATG  
GATGNACTATGCTGGTCTACGAGAGGATATGTACCAACAAACGGTGCAGAAGATTGCTACCAGTTAGA  
AAGTCAAGGTTTTACCAATATAGCAGATTTTTCTAAGGACGGCGGGGAGCCTTTCTTTATGAAGGACAC  
CATTCACCTTGTTGGTTGGTTGGTTGGCTTTTGACAAGGCAGTTGATCCTTTCCTATCCAATCCCAC  
ACCAGCTCCGACTTACCATCTGAATGAGCGCTTTTTCAGCAAAGATTGGGCGACTTATGATGGAGATGT  
CAAAGAA

**SP038 amino acid (SEQ ID NO:58)**

TEMHNLGAEKRSVATTIDSFKERSQKVRALSDPNVRFVPPFGSSEWLRFDGAHSAVLAEKYNRSYRP  
YLLQGGAASLNQYFGMQMLPQLENKQVVYVIS PQWFSKNGYDPAAFQQYFNGDQLTSFLKHQSGDQA  
SQYAATRLLOQFPNVAMKDLVQKLASKEELSTADNEMI ELLARFNERQASFFGQFSVRGVVNYDKHVAK  
YLKILPDQFSYQAI EDVVKADA EKNTSNEMGMENYFYNEQIKKDLKKL KDSQKSFTYLSPEYNXLQL  
VLTQFSKSKVNPIFII PPVNKKWMXYAGLREDMYQQTVQKIRYQLESQGFNIADFSKDGGEPPFMKDT  
IHLGWLGLAFDKAVDPFLSNPTPAPTYHLNERFFSKDWATYDGDVKE

**SP039 nucleotide (SEQ ID NO:59)**

GGTTTTGAGAAAGTATTTGCAGGGGGCCCTGATTGAGTCGATTGAGCAAGTGGAATGACCGTATTGT  
GGAAATTACAGTTTCCAATAAAAAACGAGATTGGAGACCATATCCAGGCTACCTTGATTATCGAAATTAT  
GGGGAAACACAGTAATATTCTACTGGTCGATAAAAGCAGTCATAAAATCCTCGAAGTTATCAAACACGT  
CGGCTTTTCAAAAATAGCTACCGCACCTTACTTCCAGGATCGACCTATATCGCTCCGCCAAGTACAAA  
ATCTCTCAATCCTTTTACTATCAAGGATGAAAAGCTCTTTGAAATCCTGCAAACCCAAGAATAACAGC  
AAAAATCTTCAAAGCCTCTTTCAAGGTCTGGGACGCGATACGGCAAATGAATTGGAAAGGATACTGGT  
TAGTGAAAAAATTTCCGCTTTCCGAAATTTTTCATCAAGAAACCAAGCCATGCTTGACTGAGACTTC  
CTTCAGTCCAGTTCTTTTGCAAATCAGGTGGGAGAGCCTTTTGCAAATCTTTCTGATTTGTTGGACAC  
CTACTATAAGGATAAGGCTGAGCGCGACCGCGTCAAACAGCAGGCCAGTGAAGTATTGCTCGTGTGTA  
AAATGAACCTTCAGAAAAACCGACACAACTCAAAAAACAGGAAAAAGAGTTACTGGCGACAGACAACGC  
TGAAGAATTTCTGCAAAAAGGAGAATTGCTGACAACCTTCCTCCACCAAGTGCCTAACGACCAAGACCA  
GGTTATCCTAGACAATACTATACCAACCAACCTATCATGATTGCGCTTGATAAGGCTCTGACTCCCAA  
CCAGAATGCCAACGCTATTTTAAACGGTATCAGAACTCAAAGAAGCTGTCAAATACTTGACTGATTT  
GATTGAAGAAACCAAAGCCACTATTCTCTATCTGGAAAGTGTAGAAACCGTCTCAACCAAGCTGGACT  
GGAAGAAATCGCTGAAATCCGTGAAGAATTGATTCAAACAGGTTTTATCCGCAGAAGACAACGGGAGAA  
AATCCAGAAACGCAAAAACTAGACAATATCTAGCAAGCGATGGCAAAACCATCATCTATGTCCGGACG  
AAACAATCTTCAAATGAGGAATTGACCTTTTAAATGGCCCGCAAGGAGGAACCTTTGGTTCCATGCTAA  
GGACATTCTGGAAGCCATGTTGTCATCTCAGGAAATCTTGACCCATCTGATGCAGTCAAGACAGACGC



Table 1

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AGCAGAGTTAGCTGCCTACTTCTCTCAAGGGCGCCTGTGCAATCTGGTGCAGGTAGATATGATTGAAGT  
CAAAAACTCAATAAACCACTGGTGGAAAACCCGGCTTTGTCACTTACACAGGACAAAAGACCCCTCCG  
CGTCACACCAGACTCCAAAAAATTGCATCCATGAAAAAATCC

**SP039 amino acid (SEQ ID NO:60)**

VLRYLQGALIESIEQVENDRIVEITVSNKNEIGDHIQATLIEIMGKHSNILLVDKSSHKILEVIKHV  
GFSQNSYRTLLPGSTYIAPPSTKSLNPFTIKDEKLFEILQTQELTAKNLQSLFQGLGRDTANELERILV  
SEKLSAFRNFFNQETKPCLTETSFSPVPFANQVGEFFANLSDLLDTYYKDKAERDRVKKQASELIRVE  
NELQKNRHKLKKQEKELLATDNAEEFRQKGELLTFLHQVPNDQDQVILDNYITNQPIMIALDKALTPN  
QNAQRYFKRYQKLKEAVKYLTDLIEETKATILYLESVETVLNQAGLEEIAEIREELIQTGFIRRRQREK  
IQKRKKLEQYLASDGKTIIVYGRNNLQNEELTFKMARKEELWFHAKDIPGSHVVISGNLDPSDAVKTD  
AELAAVFSQGRLSNLVQVDMIEVKKLNKPTGGKPGFVITYTGQKTLRVTPDSKKIASMKKS

**SP040 nucleotide (SEQ ID NO:61)**

GACAACATTTACTATCCATACAGTAGAGTCAGCACCAGCAGAAAGTGAAGAAATTTCTTGAAACAGTAGA  
AAAAGACAACAATGGCTATATTCCCAACCTAATCGGTCTCTTGGCCAATGCCCCGACTGTTTTAGAAGC  
CTACCAAATTTGTCTCATCTATCCACCGTCGCAACAGCCTGACACCCGTTGAGCGTGAAGTGGTGCAAT  
CACGGCAGCCGTGACCAATGGTTGTGCCTTCTGTGTGCGAGGTCACACAGCCTTTTCCATCAAACAAT  
CCAGATGAATGATGACTTGATTCAAGCTCTTCGCAATCGTACTCCAATTGAAACAGATCCTAAATTGGA  
TACCCTAGCTAAGTTTACCTTGGCAGTTATCAATACCAAGGGTCGTGTAGGAGATGAAGCCTTGTCTGA  
GTTTTTAGAAGCTGGCTACACTCAACAAAATGCCTTGGATGTGGTTTTTGGTGTGAGCCTAGCAATCCT  
CTGTAATATGCCAACAACTTAGCTAATACACCAATTAATCCAGAATTGCAACCTTATGCC

**SP040 amino acid (SEQ ID NO:62)**

TTFTIHTVESAPAEVKEILETVEKDNNGYIPNLIGLLANAPTIVLEAYQIVSSIHRNSLTPVEREVVQI  
TAAVTNGCAFCVAGHTAFSIKQIQMNDLIQALRNRTPIETDPKLDTLAKFTLAVINTKGRVGDALSE  
FLEAGYTQONALDVVFGVSLAILCNVANLANLTPINPELQPYA

**SP041 nucleotide (SEQ ID NO:63)**

GGCTAAGGAAAGAGTGGATGTACTAGCTTATAAACAGGGGTTGTTTGAAACGAGAGAGCAGGCCAAGCG  
AGGTGTGATGGCTGGCCTAGTCGTAGCAGTCCTTAATGGAGAACGGTTTGACAAGCCAGGAGAGAAAAT  
TCCAGATGACACCGAATTAAAACTCAAGGGGGAGAAAATCAAGTATGTCAGCCGTGGTGGTTTGAACT  
GGAAAAGGCCTTGAGGTCTTTGATTTGTGCGGTGGATGGCGCGACTACGATTGATATCGGGGCCTCTAC  
TGGAGGTTTTACCGATGTCTGCTACAGAATAGTGCCAAGTTGGTCTTTGCAGTCGATGTTGGTACCAA  
TCAGTTGGCTTGGAATACGCCAAGACCCACGAGTTGTCAGCATGGAGCAGTTCAATTTCCGCTATGC  
TGAAAAGACTGATTTGAGCAGGAGCCGAGCTTTGCCAGTATTGATGTGAGTTTCATTTCCCTTAGTCT  
GATTTTGCCAGCCTTGCACCGTGTCTTGGCTGATCAAGGTCAGGTGGTAGCACTTGTCAAACCTCAGTT  
TGAGGCAGGACGTGAGCAGATTGGGAAAAATGGAATTATTCGAGATGCTAAGGTTTCATCAGAATGTCTT  
TGAATCTGTAACAGCTATGGCAGTAGAGGTAGGTTTTTCAGTCCTTGGCTTGGACTTTTCTCCCATCCA  
AGGTGGACATGGAAATATTGAATTTTTAGCGTATTGAAAAAGAAAAGTCAGCAAGCAATCAGATTCT  
TGCTGAGATTAAAGAAGCAGTAGAGAGGGCGCATAGTCAATTTAAAAATGAA

**SP041 amino acid (SEQ ID NO:64)**

AKERVDVLAYKQGLFETREQAKRGVMAGLVVAVLNGERFDKPGEKIPDDTELKLKGEKLYVSRGGLKL  
EKALQVFDLSVDGATTIDIGASTGGFTDVMLQNSAKLVFAVDVGTNQLAWKLQDPRVVSMEQFNFRYA  
EKTDFEQEPSFASIDVSFISLSLILPALHRVLADQGQVVALVKPQFEAGREQIGKNGIIRDAKVHQNVL  
ESVTAMAVEVGFSVLGLDFSPIQGGHGNIEFLAYLKKEKSASNQILAEIKEAVERAHSQFKNE

**SP042 nucleotide (SEQ ID NO:65)**

TTGTTCTCTATGAACCTGGTCGTCACCAAGCTGGTCAGGTTAAGAAAGAGTCTAATCGAGTTTCTTATAT  
AGATGGTGATCAGGCTGGTCAAAAGGCAGAAAATTTGACACCAGATGAAGTCAGTAAGAGGGAGGGGAT  
CAACGCCGAACAAATNGTNATCAAGATTACGGATCAAGGTTATGTGACCTCTCATGGAGACCATTATCA  
TTACTATAATGGCAAGGTTCTTATGATGCCATCATCAGTGAAGAGCTCCTCATGAAAGATCCGAATTA  
TCAGTTGAAGGATTACAGACATTGTCAATGAAATCAAGGGTGGTTATGTCATTAAGGTAAACGGTAAATA  
CTATGTNTACCTTAAGGATGCAGCTCATGCGGATAATATTCGGACAAAAGAAGAGATTAAACGTCAGAA  
GCAGGAACGCAGTCATAATCATACTCAAGAGCAGATAATGCTGTTGCTGCAGCCAGAGCCCCAAGGACG  
TTATACAACGGATGATGGGTATATCTTCAATGCATCTGATATCATTGAGGACACGGGTGATGCTTATAT  
CGTTCTCTCAGGCGACCATACCATTACATTCCTAAGAATGAGTTATCAGCTAGCGAGTTAGCTGCTGC

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Table 1

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AGAAGCCTATTGGAATGGGAAGCAGGGATCTCGTCCTTCTTCAAGTTCTAGTTATAATGCAAATCCAGC  
TCAACCAAGATTGTGTCAGAGAACCACAATCTGACTGTCACTCCAACCTATCATCAAAATCAAGGGGAAAA  
CATTTTCAAGCCTTTTACGTGAATTGTATGCTAAACCTTATCAGAACGCCATGTGGAATCTGATGGCCT  
TATTTTCGACCCAGCGCAAATCACAAGTCGAACCGCCAGAGGTGTAGCTGTCCCTCATGGTAACCATTA  
CCACTTTATCCCTTATGAACAAATGTCTGAATTGGAACCAAGTTCGCTGATTTATCCCTTCGTTA  
TCGTTCAAACCATTTGGGTACCAGATTCAAGACCAGAACAACCAAGTCCACAATCGACTCCGGAACCTAG  
TCCAAGTCCGCAACCTGCACCAAATCCTCAACCAGCTCCAAGCAATCCAATTGATGAGAAATTGGTCAA  
AGAAGCTGTTGAAAAGTAGGCGATGGTTATGTCTTTGAGGAGAATGGAGTTTCTCGTTATATCCCAGC  
CAAGGATCTTTCAGCAGAAAACAGCAGCAGGCATTGATAGCAAACTGGCCAAGCAGGAAAGTTTATCTCA  
TAAGCTAGGAGCTAAGAAAACAGCCTCCCATCTAGTAGTCGAGAATTTACAATAAGGCTTATGACTT  
ACTAGCAAGAATTCACCAAGATTTACTTGATAATAAAGGTGCGACAAGTTGATTTTGAGGCTTTGGATAA  
CCTGTTGGAACGACTCAAGGATGTCNCAAGTGATAAAGTCAAGTTAGTGGANGATATTCCTTGCTTCTT  
AGCTCCGATTTCGTATCCAGAACGTTTAGGAAAACCAAATGCGCAAATTACCTACACTGATGATGAGAT  
TCAAGTAGCCAAGTTGGCAGGCAAGTACACAACAGAAGACGGTTATATCTTTGATCCTCGTGATATAAC  
CAGTGATGAGGGGGATGCCTATGTAACCTCACATATGACCCATAGCCACTGGATTAAAAAAGATAGTTT  
GTCTGAAGCTGAGAGAGCGGCAGCCAGGCTTATGCTAAAGAGAAAGGTTTGACCCCTCCTTCGACAGA  
CCATCAGGATTCAGGAAATACTGAGGCAAAAGGAGCAGAAGCTATCTACAACCGCGTGAAAGCAGCTAA  
GAAGGTGCCACTTGATCGTATGCCTTACAATCTTCAATATACTGTAGAAGTCAAAAACGGTAGTTTAAT  
CATACCTCATTATGACCATTACCATAACATCAAATTTGAGTGTTTGACGAAGGCCTTTATGAGGCACC  
TAAGGGGTATACCTTTGAGGATCTTTTGGCGACTGTCAAGTACTATGTGCAACATCCAAACGAACGTCC  
GCATTACAGATAATGGTTTTGGTAACGCTAGCGACCATGTTCAAAGAAAACAAAATGGTCAAGCTGATAC  
CAATCAAACGGAAAAACCAAGCGAGGAGAAACCTCAGACAGAAAAACCTGAGGAAGAAACCCCTCGAGA  
AGAGAAACCGCAAAGCGAGAAACCAGAGTCTCCAAAACCAACAGAGGAACCAGAAGAATCACCAGAGGA  
ATCAGAAGAACCTCAGGTCGAGACTGAAAAGGTTGAAGAAAAACTGAGAGAGGCTGAAGATTTACTTGG  
AAAAATCCAGGAT

**SP042 amino acid (SEQ ID NO:66)**

CSYELGRHQAGQVKESNRVSYIDGDQAGQKAENLTPDEVSKREGINAEQXVIKITDQGYVTSBGDHYH  
YYNGKVPYDAIISEELLMKDPNYQLKDSIDVNEIKGGYVIKVNKYYVYLKDAHADNIRTKEEIKRQK  
QERSHNHNSRADNAVAAARAQGRYTTDDGYIFNASDIIEDTGDAYIVPHGDHYHYIPKNELASELAAA  
EAYWNGKQGSRPSSSSSYNANPAQPRLSNHNLTVTPTYHQNGENISSLLRELYAKPLSERHVESDGL  
IFDPAQITSRTARGVAVPHGNHYHFIPYEQMSELEKRIARIIPLYRSNHWVPDSRPEQSPQSTPEPS  
PSPQPAPNPQPAPSNPIDKLVEAVRKVGDDGYVFEENGVSRYIPAKDLAETAAGIDSKLAKQESLSH  
KLGAKKTDLPSSDREFYNKAYDLLARIHQDLLDNKGRQVDFEALDNLLERLKDVXSDKVLVXDILAF  
APIRHPERLKGPNQITYTDDIEIQVAKLAGKYTTEDGYIFDPRDITSDEGDAYVTPHMTSHWIKKDSL  
SEAERAAAQAYAKEKGLTPSTDHQDSGNTAEKGAEIYNRVKAAKVPDRMPYNLQYTVVEVKNGLI  
IPHYDHYHNIKFEWFDEGLYEAPKGYTLEDLLATVKYYVEHPNERPHSDNGFGNASDHVQRNKNQADT  
NQTEKPSEKPKQTEKPEEETPREKPKQSEKPKPTEPEEPEESEPQVETEKVEEKLREAEDLLG  
KIQD

**SP043 nucleotide (SEQ ID NO:67)**

TTATAAGGGTGAATTAGAAAAAGGATACCAATTTGATGGTTGGGAAATTTCTGGTTTTCGAAGGTAAAAA  
AGACGCTGGCTATGTTATTAATCTATCAAAAGATACCTTTATAAAACCTGTATTCAAGAAAATAGAGGA  
GAAAAAGGAGGAAGAAAATAAACCTACTTTTGATGTATCGAAAAAGAAAGATAACCCACAAGTAAACCA  
TAGTCAATTAAATGAAAGTCACAGAAAAGAGGATTTACAAAGAGAAGAGCATTACAAAAAATCTGATTC  
AATAAGGATGTTACAGCTACAGTTCTTGATAAAAAACAATATCAGTAGTAAATCAACTACTAACAATCC  
TAATAAG

**SP043 amino acid (SEQ ID NO:68)**

YKGELEKGYQFDGWEISGFEGKKDAGYVINLSKDTFIKPVFKKIEEKKEEENKPTFDVSKKKDNPNQVNH  
SQLNESHKEDLQREEHSQKSDSTKDVTATVLDKNNISKSSTNNPNK

**SP044 nucleotide (SEQ ID NO:69)**

GAATGTTTCAGGCTCAAGAAAGTTCAGGAAATAAAATCCACTTTATCAATGTTCAAGAAGGTGGCAGTGA  
TGCGATTATTTCTTGAAGCAATGGACATTTTGCCATGGTGGATACAGGAGAAGATTATGATTTCCAGGA  
TGGAAGTGATTCTCGCTATCCATGGAGAGAAGGAATTGAAACGTCTTATAAGCATGTTCTAACAGACCG  
TGTCTTTTCGTCGTTTGAAGGAATTGGGTGTCCAAAAACTTGATTTTATTTTGGTGACCCATACCCACAG  
TGATCATATTGGAAATGTTGATGAATTACTGTCTACCTATCCAGTTGACCGAGTCTATCTTAAGAAATA

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Table 1

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TAGTGATAGTCGTATTACTAATTCTGAACGTCTATGGGATAATCTGTATGGCTATGATAAGGTTTTACA  
GACTGCTGCAGAAAAAGGTGTTTTAGTTATTCAAAATATCACACAAGGGGATGCTCATTTTCAGTTTGG  
GGACATGGATATTACAGCTCTATAATTATGAAAATGAACTGATTATCGGGTGAATTAAGAAAAATTTG  
GGATGACAATTCGAATTCCTTGATTAGCGTGGTGAAAGTCAATGGCAAGAAAAATTTACCTTGGGGGCGA  
TTTAGATAATGTTTCATGGAGCAGAAGACAAGTATGGTCTCTCATTTGGAAAAAGTTGATTGATGAAGTT  
TAATCATCACCATGATACCAACAAATCAAATACCAAGGATTTTCAAAAAATTTGAGTCCGAGTTTGAT  
TGTTCAAACCTTCGGATAGTCTACCTTGGAAAAATGGTGTGATAGTGAAGTATGTTAATTGGCTCAAAGA  
ACGAGGAATTGAGAGAATCAACGCAGCCAGCAAAGACTATGATGCAACAGTTTTTTGATATTCGAAAAGA  
CGGTTTTGTCAATATTTCAACATCCTACAAGCCGATTCGAAGTTTTCAAGCTGGTTGGCATAAGAGTGC  
ATATGGGAACCTGGTGGTATCAAGCGCTGATTCTACAGGAGAGTATGCTGTCGGTTGGAATGAAATCGA  
AGGTGAATGGTATTACTTTAACCACGCGGTATCTTGTACAGAATCAATGGAAAAAATGGAACAATCA  
TTGGTTCTATTTGACAGACTCTGGTGCTTCTGCTAAAAATTTGGAAGAAAAATCGCTGGAATCTGGTATTA  
TTTTAACAAAGAAAACCAGATGGAATTTGGTTGGATTCAAGATAAAGAGCAGTGGTATTATTTGGATGT  
TGATGGTTCTATGAAGACAGGATGGCTTCAATATATGGGGCAATGGTATTACTTTGCTCCATCAGGGGA  
A

**SP044 amino acid (SEQ ID NO:70)**

NVQAQESSGNKIHFINVQEGGSDAIIIESNGHFAMVDTGEDYDFPDGSDSRYPWREGIETSYKHLVLTDR  
VFRRLKELGVQKLDIFILVTHTHSDHIGNVDELLSTYPVDRVYLKKYSDSRITNSERLWDNLYGYDKVLQ  
TAAEKGVSVIQNITQGDHAFQFGMDIQLNYENETDSSGELKKIWDNNSNLSISVVKVNGKKIYLGDD  
LDNVHGAEDKYGPLIGKVDLMKFNNHHDTNKSNTKDFIKNLSPLIVQTSDSL PWKNGVDSEYVNWLKE  
RGIERINAASKDYDATVFDIRKDG FVNISTSYKPIPSFQAGWHKSAYGNWWYQAPDSTGEYAVGWNEIE  
GEWYYFNQTGILLQNWKKWNHWFYLTDSGASAKNWKIAGIWIYYFNKENQMEIGWIQDKEQWYYLDV  
DGSMTKGWLQYMGQWYYFAPSGE

**SP045 nucleotide (SEQ ID NO:71)**

CTTGGGTGTAACCCATATCCAGCTCCTTCCAGTCTTGTCTTACTACTTTGTCAATGAATTGAAAAACCA  
TGAACGCTTGTCTGACTACGCTTCAAGCAACAGCAACTACAACCTGGGGATATGACCCTCAAACTACTT  
CTCCTTGACTGGTATGTACTCAAGCGATCCTAAGAATCCAGAAAAACGAATCGCAGAATTTAAAAACCT  
CATCAACGAAATCCACAAACGTGGTATGGGAGCTATCCTAGATGTCGTTTATAACCACACAGCCAAAGT  
CGATCTCTTTGAAGATTTGGAACCAAACTACTACCCTTTATGGATGCCGATGGCACACCTCGAACTAG  
CTTTGGTGGTGGACGCTTGGGGACAACCCACCATATGACCAAACGGCTCCTAATTGACTCTATCAAATA  
CCTAGTTGATACCTACAAAGTGGATGGCTTCCGTTTCGATATGATGGGAGACCATGACGCCGCTTCTAT  
CGAAGAAGCTTACAAGGCTGCACGCGCCCTCAATCCAAACCTCATCATGCTTGGTGAAGGTTGGAGAAC  
CTATGCCGGTGATGAAAACATGCCTACTAAAGCTGCTGACCAAGATTGGATGAAACATACCGATACTGT  
CGCTGTCTTTTCAGATGACATCCGTAACAACCTCAAATCTGGTTATCCAAACGAAGGTCAACCTGCCTT  
TATCACAGGTGGCAAGCGTGATGTCAACACCATCTTTAAAAATCTCATTGCTCAACCAACTAACTTTGA  
AGCTGACAGCCCTGGAGATGTCAATACATCGCAGCCCATGATAACTTGACCCTCTTTGACATCAT  
TGCCCAGTCTATCAAAAAAGACCCAAGCAAGGCTGAGAACTATGCTGAAATCCACCGTCGTTTACGACT  
TGGAATCTCATGGTCTTGACAGCTCAAGGAACTCCATTTATCCACTCCGGTCAGGAATATGGACGTAC  
TAAACAATTCGGTGACCCAGCCTACAAGACTCCAGTAGCAGAGGATAAGGTTCCAAACAAATCTCACTT  
GTTGCGTGATAAGGACGGCAACCCATTTGACTATCCTTACTTCATCCATGACTCTTACGATTCTAGTGA  
TGCAGTCAACAAGTTTGACTGGACTAAGGCTACAGATGGTAAAGCTTATCCTGAAAATGTCAAGAGCCG  
TGACTATATGAAAGGTTTGATTGCCCTTCGTCAATCTACAGATGCCTTCCGACTTAAGAGTCTTCAAGA  
TATCAAAGACCGTGTCCACCTCATCACTGTCCAGGCCAAAATGGTGTGGAAAAAGAGGATGTAGTGAT  
TGGCTACCAAAATCACTGCTCCAAACGGCGATATCTACGCAGTCTTTGTCAATGCGGATGAAAAAGCTCG  
CGAATTTAATTTGGAACCTGCCTTTGCACATCTAAGAAATGCGGAAGTTTTGGCAGATGAAAACCAAGC  
AGGACCAGTCGGAATTGCCAACCCGAAAGGACTTGAATGGACTGAAAAAGGCTTGAATTTGAATGCCCT  
TACAGCTACTGTTCTTTCAGTCTCTCAAAATGGAAGTACCATGAGTCAACTGCAGAAGAGAAACCAGA  
CTCAACCCCTTCCAAGCCTGAACATCAAAATGAAGCTTCTCACCCCTGCACATCAAGACCCAGCTCCAGA  
AGCTAGACCTGATTCTACTAAACCAGATGCCAAAGTAGCTGATGCGGAAAATAAACCTAGCCAAGCTAC  
AGCTGATTACAAAGCTGAACAACCAGCACAGAAGCACAAAGCATCATCTGTAAAAGAAGCGGTTTCGAAA  
CGAATCGGTAGAAAACCTTAGCAAGGAAAATATACCTGCAACCCAGATAAACAAGCTGAA

**SP045 nucleotide (SEQ ID NO:72)**

LGVTHIQLLPVLSSYYFVNELKNHERLSDYASSNSNYNWGYDPQNYFSLTGMYSDDPKNPEKRIAEFKNL  
INEIHKRGMGAILDVVYNHTAKVDLFEDLEPNYYHFMDADGTPRTSFGGGRGLGTHHMTKRLIDS IKY  
LVDTYKVDGFRFDMMDHDAASIEEAYKAARALNPNLIMLGEGWRTYAGDENMPTKAADQDWMKHTDTV

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Table 1

AVFSDDIRNNLKSYPNEGQPAFITGGKRDVNTIFKNLIAQPTNFEADSPGDVIQYIAAHDNLTLFDII  
AQSIKDPKSKAENYAEIHRRLRLGNLMVLTAQGTFFIHSGQEYGRTKQFRDPAYKTPVAEDKVPNKSHL  
LRDKDGNPFDPYFIHDSYDSSDAVNKFDWTKATDGKAYPENVKSRDYMKGILALRQSTDAFRLKSLQD  
IKDRVHLITVPGQNGVEKEDVVIGYQITAPNGDIYAVFVNADEKAREFNLGTAFHLRNAEVLADENQA  
GPVGIANPKGLEWTEKGLKLNALTATVLRVSQNGTSHESTAEKPDSTPSKPEHQNEASHPAHQDPAPE  
ARPDSTKPDADAKVADAENKPSQATADSQAEQPAQEAQASSVKEAVRNESVENSSKENIPATPDKQAE

**SP046 nucleotide (SEQ ID NO:73)**

TAGTGATGGTACTTGGCAAGGAAAACAGTATCTGAAAGAAGATGGCAGTCAAGCAGCAAATGAGTGGGT  
TTTNGATACTCATTATCAATCTTGGTTCTATATAAAGCAGATGCTAACTATGCTGAAAATGAATGGCT  
AAAGCAAGGTGACGACTATTTTTACCTCAAATCTGGTGGCTATATGGCCAAATCAGAATGGGTAGAAGA  
CAAGGGAGCCTTTTATTATCTTGACCAAGATGGAAAGATGAAAAGAAATGCTTGGGTAGGAACCTCCTA  
TGTTGGTGCAACAGGTGCCAAAGTAATAGAAGACTGGGTCTATGATTCTCAATACGATGCTTGGTTTTA  
TATCAAAGCAGATGGACAGCAGCAGAGAAAGAATGGCTCCAAATTAAGGGAAGGACTATTATTTCAA  
ATCCGGTGGTTATCTACTGACAAGTCAGTGGATTAATCAAGCTTATGTGAATGCTAGTGGTGCCAAAGT  
ACAGCAAGGTGGCTTTTTGACAAACAATACCAATCTTGGTTTTACATCAAAGAAAATGGAACTATGC  
TGATAAAGAATGGATTTTCGAGAATGGTCACTATTATTATCTAAAATCCGGTGGCTACATGGCAGCCAA  
TGAATGGATTTGGGATAAGGAATCTTGGTTTTATCTCAAATTTGATGGGAAAATGGCTGAAAAGAATG  
GGTCTACGATTCTCATAGTCAAGCTTGGTACTACTTCAAATCCGGTGGTTACATGACAGCCAATGAATG  
GATTTGGGATAAGGAATCTTGGTTTTACCTCAAATCTGATGGGAAAATAGCTGAAAAGAATGGGTCTA  
CGATTCTCATAGTCAAGCTTGGTACTACTTCAAATCTGGTGGCTACATGGCGAAAATGAGACAGTAGA  
TGGTTATCAGCTTGAAGCGATGGTAAATGGCTTGGAGGAAAACTACAAATGAAAATGCTGCTTACTA  
TCAAGTAGTGCCTGTTACAGCCAATGTTTATGATTGAGATGGTGAAAAGCTTTCTTATATATCGCAAGG  
TAGTGTGCTATGGCTAGATAAGGATAGAAAAAGTGATGACAAGCGCTTGGCTATTACTATTCTGGTTT  
GTCAGGCTATATGAAAACAGAAGATTTACAAGCGCTAGATGCTAGTAAGGACTTTATCCCTTATTATGA  
GAGTGATGGCCACCGTTTTTATCACTATGTGGCTCAGAATGCTAGTATCCCAGTAGCTTCTCATCTTC  
TGATATGGAAGTAGGCAAGAAATATTATTCGGCAGATGGCCTGCATTTTGATGGTTTTAAGCTTGAGAA  
TCCCTTCTTTTTCAAAGATTTAACAAGAGGCTACAAACTACAGTGTGAAGAATTGGATAAGGTATTTAG  
TTTGCTAAACATTAACAATAGCCTTTTGGAGAACAAGGGCGCTACTTTTAAGGAAGCCGAAGAACATTA  
CCATATCAATGCTCTTTATCTCTTGGCCATAGTGCCCTAGAAAAGTAACCTGGGGAAGAAGTAAAATTGC  
CAAAGATAAGAATAATTTCTTTGGCATTACAGCCTATGATACGACCCCTTACCTTTCTGCTAAGACATT  
TGATGATGTGGATAAGGGAATTTTAGGTGCAACCAAGTGGATTAAGGAAAATTATATCGATAGGGGAAG  
AACTTTCTTGGAAACAAGGCTTCTGGTATGAATGTGGAATATGCTTCAGACCCTTATTGGGGCGAAAA  
AATTGCTAGTGTGATGATGAAAATCAATGAGAAGCTAGGTGGCAAAGAT

**SP046 amino acid (SEQ ID NO:74)**

SDGTWQGKQYLKEDGSQAANEVVDTHYQSWFYIKADANYAENEWLKQGDDYFYLKSGGYMAKSEWVED  
KGAFYYLDQDGKMKRNAVVGTSYVGATGAKVIEDWVYDSQYDAWFYIKADGQHAKEWLQIKGKDYYFK  
SGGYLLTSQWINQAYVNASGAKVQQGWLFQYQSWFYIKENGNVADKEWIFENGHYYYLKSAGGYMAAN  
EWIWDKESWFYLFKFDGKMAEKWVYDSHSQAWYFYSKSGGYMTANEWIWDKESWFYLFKSDGKIAEKWVY  
DSHSQAWYFYSKSGGYMAKNETVDGYQLGSDGKWLGGKTTNENAAYYQVVPVTANVYDSDGEKLSYISQ  
SVVWLDKDRKSDDKRLAITISGLSGYMKTEDLQALDASKDFIPYYESDGRFHYHYVAQNASIPVASHLS  
DMEVGKKYYSADGLHFDGFKLENPFLFKDLTEATNYSAEELDKVFSLLNINNSLLENKGATFKEAEEHY  
HINALYLLAHSALSNWGRSKIADKNNFFGITAYDTPYLSAKTFDDVDKGILGATKWIKENYIDRGR  
TFLGNKASGMNVEYASDPYWGKIASVMMKINEKLGGKD

**SP048 nucleotide (SEQ ID NO:75)**

TGGGATTCAATATGTCAGAGATGATACTAGAGATAAAGAAGAGGGAATAGAGTATGATGACGCTGACAA  
TGGGGATATTATTGTAAAAGTAGCGACTAAACCTAAGGTAGTAACCAAGAAAATTTCAAGTACGCGAAT  
TCGTTATGAAAAGATGAAACAAAAGACCGTAGTGAAAATCCTGTTACAATTGATGGAGAGGATGGCTA  
TGTAACCTACGACAAGGACCTACGATGTTAATCCAGAGACTGGTTATGTTACCGAACAGGTTACTGTTGA  
TAGAAAAGAAGCCACGGATACAGTTATCAAAGTTCAGCTAAAAGCAAGGTTGAAGAAGTTCTTGTTC  
ATTTGCTACTAAATATGAAGCAGACAATGACCTTTCTGCAGGACAGGAGCAAGAGATTACTCTAGGAAA  
GAATGGGAAAACAGTTACAACGATAACTTATAATGTAGATGGAAAGAGTGGACAAGTAAGTGAAGTAC  
TTTAAGTCAAAAAAAGACTCTCAAACAAGAGTTGTTAAAAAAGAACCArKCCCCAAGTTCTTGTCCA  
AGAAATTCCAATCGAAACAGAATATCTCGATGGCCCACTCTTGATAAAAGTCAAGAAGTAGAAGAAGT  
AGGAGAAATTGGTAAATTACTCTTACTACAATCTATACTGGTAGATGAACGTGATGGAACAATTGAAGA  
AACTACTTCTCGTCAAATTACTAAAGAGATGGTAAAAAGACGTATAAGGAGAGGGACGAGAGAACCTGA

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Table 1

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AAAAGTTGTTGTTCCCTGAGCAATCATCTATTCCTTCGTATCCTGTATCTGTTACATCTAACCAAGGAAC  
AGATGTAGCAGTAGAACCAGCTAAAGCAGTTGCTCCAACAACAGACTGGAAACAAGAAAATGGTATGTG  
GTATTTTATAAATACTGATGGTTCATGGCAACAGGTTGGGTACAAGTTAATAGTTCATGGTACTACCT  
CAACAGCAACGGTTCATGAAAGTCAATCAATGGTTCGAAGTTGGTGGTAAATGGTATTATGTAAATAC  
ATCGGGTGAGTTAGCGGTCAATACAAGTATAGATGGCTATAGAGTCAATGATAATGGTGAATGGGTGCG  
T

**SP048 amino acid (SEQ ID NO:76)**

GIQYVRDDTRDKEEGIEYDDADNGDIIVKVATKPKVVTKKISSSTRIRYEKDETKDRSENPTIDGEDGY  
VTTTRTYDVNPETGYVTEQVTVDRKEATDTVIKVPKSKVEEVLVPFATKYEADNDLSAGQEIEITLGK  
NGKTVTTITYNVNDGKSGQVTESTLSQKKDSQTRVVKKRTXPQVLVQEIPIETEYLDGPTLDKSQEVEEV  
GEIGKLLLLQSILVDERDGTIEETTSRQITKEMVKRRIRRGTREREKVVVPEQSSIPSPVSVTSNQG  
DVAVEPAKAVAPTDDWKQENGMMWYFYNTDGSMTGWVQVNSSWYLLNSNGSMKVNQWFQVGGKWWYVNT  
SGELAVNTSIDGYRVNDNGEWR

**SP049 nucleotide (SEQ ID NO:77)**

GGATAATAGAGAAGCATTAAAAACCTTTATGACGGGTGAAAATTTTATCTCCAACATTATCTAGGAGC  
ACATAGGGAAGAACTAAATGGAGAGCATGGCTATACCTTCCGTGTTTGGGCACCTAATGCTCAGGCTGT  
TCACTTGGTTGGTGATTTTACCAACTGGATTGAAAATCAGATTCCAATGGTAAGAAATGATTTTGGGGT  
CTGGGAAGTCTTTACCAATATGGCTCAAGAAGGGCATATTTACAAATATCATGTACACGTCAAAATGG  
TCATCAACTGATGAAGATTGACCTTTTGGCTGTGAGGTATGAGGCTCGTCCAGGAACAGGGGCAATCGT  
AACAGAGCTTCCTGAGAAGAAATGGAAGGATGGACTTTGGCTGGCACGAAGAAACGTTGGGGCTTTGA  
AGAGCGTCCGTGTAATATTTATGAAGTTCACGCTGGATCATGGAAAAGAAATCTGATGGCAGTCCTTA  
TAGTTTGGCCAGCTCAAGGATGAACCTATTCTTATCTCGTTGAAATGAACATACTCATATTGAGTT  
TATGCCCTTGATGTCCCATCTTTGGGCTTGAGTTGGGGGTATCAGCTTATGGGTACTTCGCTTTAGA  
GCATGCTTATGGCCGACCAGAGGAGTTTCAAGATTTTGTG

**SP049 amino acid (SEQ ID NO:78)**

DNREALKTFMTGENFYLLQHYLGAHREELNGEHGYTFRVWAPNAQAVHLVGDFTNWIENQIPMVRNDFGV  
WEVFTNMAQEGHIYKYHVTRQNGHQLMKIDPFAVRYEARPGTGAIIVTELPEKKWKDGLWLARRKRWGF  
ERPVNIYEVHAGSWKRNSDGPYSFAQLKDELIPYLVEMNYTHIEFMPLMSHPLGLSWGYQLMGYFALE  
HAYGRPEEFQDFV

**SP050 nucleotide (SEQ ID NO:79)**

AGATTTTGTGCGAGGAGTGTCATACCCATAATATTGGGGTTATTGTGGACTGGGTACCAGNTCACTTTAC  
CATCAACGATGATGCCTTAGCCTATTATGATGGGACACCGACTTTTGAATACCAAGACCATAATAAGGC  
TCATAACCATGGTTGGGGTGCCCTTAATTTTGACCTTGGAAAAAATGAAGTCCAGTCCTTCTTAATTTT  
TTGCATTAAAGCATTGGATTGATGTCTATCATTTGGATGGTATTCTGTGGATGCTGTTAGCAACATGCT  
CTATTTGGACTATGATGATGCTCCATGGACACCTAATAAAGATGGCGGAAATCTCAACTATGAAGGTTA  
TTATTTTCCTTACAGCGCTTGAATGAGGTTATTAAGTTAGAATATCCAGATGTGATGATGATTGCAGAAGA  
AAGTTCGTCTGCGATCAAGATTACGGGAATGAAAGAGATTGGTGGTCTAGGATTTGACTACAAATGGAA  
CATGGGCTGGATGAATGATATCCTCCGTTTCTACGAAGAAGATCCGATCTATCGTAAATATGACTTTAA  
CCTGGTGACTTTTACGCTTTATGTATGTTTCAAGGAGAATTATCTCTTGCCATTCTCGCAGGATGAAGT  
GGTTCATGGCAAGAAGAGTATGATGCATAAGATGTGGGGAGATCGTTACAATCAATTTCGAGGCTTGCG  
CAATCTCTATACGTACCAAAATTTGTCAACCTGGTAAGAAATTGCTCTTCATGGGTAGCGAATACGGTCA  
ATTCTCTAGAATGGAAATCTGAAGAACAGTTGGAATGGTCTAACCTAGAAGACCAATGAATGCTAAGAT  
GAAGTATTTGCTTCTCAGCTAAACAGTTTACAAAGATCATCGCTGTCTGTGGGAAATTGATACCAG  
CTATGATGGTATTGAAATCATTGATGCGGATAATCGAGACCAGAGTGTCTTTCTTTTATTTCGTAAGGG  
TAAAAAGGGA

**SP050 amino acid (SEQ ID NO:80)**

DFVEECHTHNIGVIVDWVPXHTINDDALAYDGTPTFEYQDHNKAHNHGWGALNFDLGKNEVQSFLIS  
CIKHWDVYHLDGIRVDAVSNNMLYLDYDDAPWTPNKDGGNLYEGYFLQRLNEVIKLEYPDVMMAIEE  
SSSAIKITGMKEIGGLGFDYKWNMGWMNDILRFYEEDPIYRKYDFNLVTF SFMYVXKENYLLPF SHDEV  
VHGKKSMMHKMWGDRYNQFAGLRNLYTYQICHGPKLLFMGSEYGFLEWKSEEQLEWSNLEDPMNAKM  
KYFASQLNQFYKDHRLWEIDTSYDGLIEIIDADNRDQSVLSFIRKGGK

**SP051 nucleotide (SEQ ID NO:81)**

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Table 1

ATCTGTAGTTTATGCGGATGAAACACTTATTACTCATACTGCTGAGAAACCTAAAGAGGAAAAAATGAT  
AGTAGAAGAAAAGGCTGATAAAGCTTTGGAACTAAAAATATAGTTGAAAGGACAGAACAAAGTGAACC  
TAGTTCAACTGAGGCTATTGCATCTGAGNAGAAAAGAAGATGAAGCCGTAACCTCCAAAAGAGGAAAAAGT  
GTCTGCTAAACCGGAAGAAAAAGCTCCAAGGATAGAATCACAAAGCTTCAAAATCAAGAAAAACCGCTCAA  
GGAAGATGCTAAAGCTGTAACAAATGAAGAAGTGAATCAAAATGATTGAAGACAGGAAAGTGGATTTTAA  
TCAAAATTTGGTACTTTAAACTCAATGCAAATTCTAAGGAAGCCATTAAACCTGATGCAGACGTATCTAC  
GTGGAAAAAATTAGATTTACCGTATGACTGGAGTATCTTTAACGATTTTCGATCATGAATCTCCTGCACA  
AAATGAAGGTGGACAGCTCAACGGTGGGGAAGCTTGGTATCGCAAGACTTTCAAACCTAGATGAAAAAGA  
CCTCAAGAAAAATGTTTCGCCTTACTTTTGTATGGCGTCTACATGGATTCTCAAGTTTATGTCAATGGTCA  
GTTAGTGGGGCATTATCCAAATGGTTATAACCAAGTCTCATATGATATCACCAAATACCTTTCAAAAAGA  
TGGTCGTGAGAATGTGATTGCTGTCATGCAGTCAACAAACAGCCAAGTAGCCGTTGGTATTTCAGGAAG  
TGGTATCTATCGTGATGTGACTTTACAAGTGACAGATAAGGTGCATGTTGAGAAAAATGGGACAACATAT  
TTTAACACCAAAACTTGAAGAACAACAACATGGCAAGGTTGAAACTCATGTGACCAGCAAAATCGTCAA  
TACGGACGACAAAGACCATGAACCTGTAGCCGAATATCAAAATCGTTGAACGAGGTGGTCATGCTGTAAC  
AGGCTTAGTTTCGTACAGCGAGTCTGACCTTAAAAGCACATGAATCAACAAGCCTAGATGCGATTTTAGA  
AGTTGAAAGACCAAACTCTGGACTGTTTTAAATGACAAACCTGCCTTGTACGAATTGATTACGCGTGT  
TTACCGTGACGGTCAATTGGTTGATGCTAAGAAGGATTTGTTTGGTTACCGTTACTATCACTGGACTCC  
AAATGAAGGTTTCTCTTTGAATGGTGAACGTATTAAATTCATGGAGTATCCTTGCACCACGACCATGG  
GGCGCTTGGAGCAGAAGAAAACATAAAGCAGAATATCGCCGCTCTCAAACAAATGAAGGAGATGGGAGT  
TAACCTCATCCGTACAACCCACAACCTTGCTAGTGAGCAAACTTGCAAATCGCAGCAGAACTAGGTTT  
ACTCGTTTCAGGAAGAGGCCTTTGATACGTGGTATGGTGGCAAGAAACCTTATGACTATGGACGTTTCTT  
TGAAAAAGATGCCACTCACCCAGAAGCTCGAAAAGGTGAAAAATGGTCTGATTTTGACCTACGTACCAT  
GGTCGAAAGAGGCAAAAACAACCTGCTATCTTCATGTGGTCAATTGGTAATGAAATAGGTGAAGCTAA  
TGGTGATGCCCACTCTTTAGCAACTGTTAAACGTTTGGTTAAGGTTATCAAGGATGTTGATAAGACTCG  
CTATGTTACCATGGGAGCAGATAAATTCGGTTTCGGTAATGGTAGCGGAGGGCATGAGAAAATTGCTGA  
TGAACCTCGATGCTGTTGGATTTAACTATTCTGAAGATAATTACAAAGCCCTTAGAGCTAAGCATCCAAA  
ATGGTTGATTTATGGATCAGAAACATCTTCAGCTACCCGTACACGTGGAAGTTACTATCGCCCTGAACG  
TGAATTGAAACATAGCAATGGACCTGAGCGTAATTATGAACAGTCAGATTATGGAAATGATCGTGTGGG  
TTGGGGGAAAACAGCAACCGCTTCATGGACTTTTGACCGTGACAACGCTGGCTATGCTGGACAGTTTAT  
CTGGACAGGTACGGACTATATTGGTGAACCTACACCATGGCACAACCAAAATCAAACCTCCTGTTAAGAG  
CTCTTACTTTGGTATCGTAGATACAGCCGGCATTCCAAAACATGACTTCTATCTCTACCAAAGC

**SP051 amino acid (SEQ ID NO:82)**

SVVYADETLITHTAEKPKKEKMIVEEKADKALETKNIVERTEQSEPSSTEALASEXKEDEAVTPKEEKV  
SAKPEEKAPRIESQASNQEKPLKEDAKAVTNEEVNQMIEDRKVDNFQNWYFKLNANSKEAIKPDADVST  
WKKLDLPYDWSIFNDFDHESPAQNEGGQLNGGEAWYRKTFKLDEKDLKKNVRLTFDGVYMDSQVYVNGQ  
LVGHYPNGYNQFSYDITKYLQKDGRENVIHVAVHNKQPSRWYSGSGIYRDVTLQVTDKVHVEKNGTTI  
LTPKLEEQHGKVVETHVTSKIVNTDDKDHELVAEYQIVERGGHAVTGLVRTASRTLKAHESTSLDAILE  
VERPKLWTVLNDKPALYELITRVYRDGQLVDAKKDLFGYRYHWTNEGFSLNGERIKFHGVSLLHHDHG  
ALGAEENYKAERYRLKQMKEMGVNSIRTTNHPASEQTLQIAAELGLLVQEEAFDTWYGGKKPYDYGRFF  
EKDATHPEARKGEKWSDFDLRTMVERGKNPFIWMFSIGNEIGEANGDAHSLATVKRLVKVIKDVKTR  
YVTMGADKFRFGNGSGGHEKIADELDAVGFNYSEDNYKALRAKHPKWLIIYGSETSSATRTRGSYYRPER  
ELKHSNGPERNYEQSDYGNDRVWGKTATASWTFDRDNAGYAGQFIWTGTDYIGEPTPHWNQNTPVKS  
SYFGIVDTAGIPKHDFYLYQS

**SP052 nucleotide (SEQ ID NO:83)**

TTACTTTGGTATCGTAGATACAGCCGGCATTCCAAAACATGACTTCTATCTCTACCAAAGCCAATGGGT  
TTCTGTAAAGAAGAAACCGATGGTACACCTTCTTCCTCACTGGAAGTGGGAAAACAAAGAATTAGCATC  
CAAAGTAGCTGACTCAGAAGGTAAGATTCCAGTTTCGTGCTTATTTCGAATGCTTCTAGTGTAGAATTGTT  
CTTGAATGGAAAATCTCTTGGTCTTAAGACTTTCAATAAAAAACAAACCAGCGATGGGCGGACTTACCA  
AGAAGGTGCAAATGCTAATGAACCTTTATCTTGAATGGAAAGTTGCCATCAACCAGGTACCTTGGAAGC  
AATTGCTCGTGATGAATCTGGCAAGGAAATGCTCGAGATAAGATTACGACTGCTGGTAAGCCAGCGGC  
AGTTTCGTCTTATTAAGGAAGACCATGCGATTGCAGCAGATGGAAAAGACTTGACTTACATCTACTATGA  
AATTGTTGACAGCCAGGGGAATGTGGTTCCAACCTGCTAATAATCTGGTTTCGTTCCAATTGCATGGCCA  
AGGTCAACTGGTGGTGTAGATAACGGAGAACAAGCCAGCCGTGAACGCTATAAGGCGCAAGCAGATGG  
TTCTTGGATTTCGTAAAGCATTTAATGGTAAAGGTGTTGCCATTGTCAAATCAACTGAACAAGCAGGGAA  
ATTACCCCTGACTGCCCACTCTGATCTCTTGAATCGAACCAAGTCACTGTCTTTACTGGTAAGAAAGA  
AGGACAAGAGAAGACTGTTTTGGGGACAGAAGTGCCAAAAGTACAGACCATTATTGGAGAGGCACCTGA

Table 1

AATGCCTACCACTGTTCCGTTTGTATACAGTGATGGTAGCCGTGCAGAACGTCTGTAACTGGTCTTC  
AGTAGATGTGAGCAAGCCTGGTATTGTAACGGTGAAAAGGTATGGCTGACGGACGAGAAGTAGAAGCTCG  
TGTAAGAAGTGATTGCTCTTAAATCAGAGCTACCAGTTGTGAAACGTATTGCTCCAAATACTGACTTGAA  
TTCTGTAGACAAATCTGTTTCTATGTTTTGATTGATGGAAGTGTTGAAGAGTATGAAGTGGACAAGTG  
GGAGATTGCCGAAGAAGATAAAGCTAAGTTAGCAATTCCAGGTTCTCGTATTCAAGCGACCGGTTATTT  
AGAAGGTCAACCAATTCATGCAACCCTTGTGGTAGAAGAAGGCAATCCTGCGGCACCTGCAGTACCAAC  
TGTAACGGTTGGTGGTGAGGCAGTAACAGGTCTTACTAGTCAAAAACCAATGCAATACCGCACTCTTGC  
TTATGGAGCTAAGTTGCCAGAAGTCACAGCAAGTGCTAAAAATGCAGCTGTTACAGTTCTTCAAGCAAG  
CGCAGCAAACGGCATGCGTGCGAGCATCTTTATTACAGCTAAAGATGGTGGCCCTCTTCAAACCTATGC  
AATTCAATTCTTGAAGAAGCGCCAAAAATTGCTCACTTGAGCTTGCAAGTGGAAGTGAAGCTGACAGTCT  
CAAAGAAGACCAAACGTGTCAAATTGTCGGTTCGAGCTCACTATCAAGATGGAACGCAAGCTGTATTACC  
AGCTGATAAAGTAACCTTCTCTACAAGTGGTGAAGGGGAAGTCGCAATTCTGTAAGGAATGCTTGAGTT  
GCATAAGCCAGGAGCAGTCACTCTGAACGCTGAATATGAGGGAGCTAAAGACCAAGTTGAAGTCACTAT  
CCAAGCCAATACTGAGAAGAAGATTGCGCAATCCATCCGTCCTGTAAATGTAGTGACAGATTTGCATCA  
GGAACCAAGTCTTCCAGCAACAGTAACAGTTGAGTATGACAAAAGGTTTCCCTAAACTCATAAAGTCAC  
TTGGCAAGCTATTCCGAAAGAAAACTAGACTCCTATCAAACATTTGAAGTACTAGGTAAAGTTGAAGG  
AATTGACCTTGAAGCGCGTGCAAAAGTCTCTGTAGAAGGTATCGTTTCAGTTGAAGAAGTCAGTGTGAC  
AACTCCAATCGCAGAAGCACCACAATTACCAGAAAGTGTTCGGACATATGATTCAAATGGTCACGTTTC  
ATCAGCTAAGGTTGCATGGGATGCGATTCTGTCAGAGCAATACGCTAAGGAAGGTGTCTTTACAGTTAA  
TGGTTCGCTTAGAAGGTACGCAATTAACA

**SP052 amino acid (SEQ ID NO:84)**

YFGIVDTAGIPKHDFLYQSQWVSVKKKPMVHLLPHWNWENKELASKVADSEGKIPVRAYSNAASSVELF  
LNGKSLGLKTFNKKQTS DGRTYQEGANANELYLEWKVAYQPGTLEAIARDESGKEIARDKITTAGKPAA  
VRLIKEDHAIADGKDLTYIYYEIVDSQGNVPTANNLVRFLHGGQQLVGVDNGEQASRERYKAQADG  
SWIRKAFNGKGAIVKSTEQAGKFTLTAHSDLLKSNQVTVFTGKKEGQEKTVLGTEVPKVQTIIGEAPE  
MPTTVPFVYSDGSRAERPVTWSSVDVSKPGIVTVKGMADGREVEARVEVIALKSELVVKKRIAPNTDLN  
SVDKSVSYVLIDGSVEEYEVDKWEIAEEDKAKLAIPGSRIQATGYLEGQPIHATLVVEEKNPAAPAVPT  
VTVGSEAVTGLTSQKPMQYRTLAYGAKLPEVTSASAKNAAVTLQASAANGMRASIFIQPKDGGPLQTYA  
IQFLEEAPKIAHLSLQVEKADSLKEDQTVKLSVRAHYQDGTQAVLPADKVTFSTSGEGEVAIRKGMLEL  
HKPGAVTLNAEYEGAKDQVELTIQANTEKKIAQSIRPVNVVTDLHQEPSLPATVTVEYDKGFPKTHKVT  
WQAIPEKELDSYQTFEVLGKVEGIDLEARAKVSVEGIVSVEEVSVTTPIAEAPQLPESVRTYDSNGHVS  
SAKVAWDAIRPEQYAKEGVFTVNGRLEGTQLT

**SP053 nucleotide (SEQ ID NO:85)**

AGCTAAGGTTGCATGGGATGCGATTCTGCCAGAGCAATACGCTAAGGAAGGTGTCTTTACAGTTAATGG  
TCGCTTAGAAGGTACGCAATTAACAATAAAGTTCATGTTTCGCGTATCTGCTCAAAGTGAAGGTCG  
AAACATTTCTGACCAATGGACCGGTTTCAAGATTGCCACTTGCTTTGCTTCAGACTCAAATCCAAGCGA  
CCCAGTTTCAAATGTTAATGACAAGCTCATTTCTTACAATAACCAACCAGCCAATCGTTGGACAAACTG  
GAATCGTACTAATCCAGAAGCTTCAGTCGGTGTCTGTTTGGAGATTACAGGTATCTTGAGCAAACGCTC  
CGTTGATAATCTAAGTGTGCGATTCCATGAAGACCATGGAGTTGGTGTACCGAAGTCTTATGTGATTGA  
GTATTATGTTGGTAAGACTGTCCCAACAGCTCCTAAAAACCTAGTTTTGTTGGTAATGAGGACCATGT  
CTTTAATGATTCTGCCAACTGGAAACAGTTACTAATCTAAAAGCCCCGTGCTCAACTCAAGGCTGGAGA  
AATGAACCACTTTAGCTTTGATAAAGTTGAAACCTATGCTGTTTCGTATTTCGCATGGTTAAAGCAGATAA  
CAAGCGTGGAACGTCTATCACAGAGGTACAAATCTTTCGCAAAACAAGTTGCGGCAGCCAAGCAAGGACA  
AACAAGAATCCAAGTTGACGGCAAAGACTTAGCAAACCTTCAACCCTGATTTGACAGACTACTACCTTGA  
GTCTGTAGATGGAAAAGTTCCGGCAGTCACAGCAAGTGTTAGCAACAATGGTCTCGCTACCGTCGTTCC  
AAGCGTTTCGTGAAGGTGAGCCAGTTTCGTGTCATCGCGAAAGCTGAAAATGGCGACATCTTAGGAGAATA  
CCGTCTGCACTTCACTAAGGATAAGAGCTTACTTTCTCATAAACCAGTTGCTGCGGTTAAACAAGCTCG  
CTTGCTACAAGTAGGTCAAGCACTTGAATTGCCGACTAAGGTTCCAGTTTACTTCACAGGTAAAGACGG  
CTACGAAACAAAAGACCTGACAGTTGAATGGGAAGAAGTTCCAGCGGAAAATCTGACAAAAGCAGGTCA  
ATTTACTGTTTCGAGGCCGTGTCTTGGTAGTAACCTTGTGCTGAGATCACTGTACGAGTGACAGACAA  
ACTTGGTGAGACTCTTTAGATAACCTTAATATGATGAAAACAGTAACCAGGCCTTTGCTTCAGCAAC  
CAATGATATTGACAAAACCTCTCATGACCGCGTTGACTATCTCAATGACGGAGATCATTAGAAAATCG  
TCGTTGGACAAACTGGTCAACCAACCATCTTCTAATCCAGAAGTATCAGCGGGTGTGATTTTCCGTGA  
AAATGGTAAGATTGTAGAACGGACTGTTACACAAGGAAAAGTTCAAGTTCTTTGCAGATAGTGGTACGGA  
TGCACCATCTAAACTCGTTTTAGAACGCTATGTCGGTCCAGAGTTTGAAGTGCCAACCTACTATTCAA  
CTACCAAGCCTACGACGCAGACCATCCATTCAACAATCCAGAAAATTGGGAAGCTGTTCTTATCGTGC



Table 1

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GGATAAAGACATTGCAGCTGGTGATGAAATCAACGTAACATTTAAAGCTATCAAAGCCAAAGCTATGAG  
ATGGCGTATGGAGCGTAAAGCAGATAAGAGCGGTGTTGCGATGATTGAGATGACCTTCCTTGCACCAAG  
TGAATTGCCTCAAGAAAGCACTCAATCAAAGATTCCTTGTAGATGGAAAAGAACTTGCTGATTTTCGCTGA  
AAATCGTCAAGACTATCAAATTACCTATAAAGGTCAACGGCCAAAAGTCTCAGTTGAAGAAAACAATCA  
AGTAGCTTCAACTGTGGTAGATAGTGGAGAAGATAGCTTTCCAGTACTTGTTCGCTCGTTTCAGAAAAG  
TGGAAAACAAGTCAAGGAATACCGTATCCACTTGACTAAGGAAAAACCAGTTTCTGAGAAGACAGTTGC  
TGCTGTACAAGAAGATCTTCCAAAAATCGAATTTGTTGAAAAAGATTGGCATACAAGACAGTTGAGAA  
AAAAGATTCAACACTGTATCTAGGTGAAACTCGTGTAGAACAAGAAGGAAAAGTTGGAAAAGAACGTAT  
CTTTACAGCGATTAATCCTGATGGAAGTAAGGAAGAAAAACCCGTGAAGTGGTAGAAGTTCCGACAGA  
CCGCATCGTCTTGGTTGGAACCAACCAGTAGCTCAAGAAGCTAAAAAACCAAGTGTGAGAAAAAGC  
AGATACAAAACCAATTGATTCAAGTGAAGCTAGTCAAACTAATAAAGCCAG

**SP053 amino acid (SEQ ID NO:86)**

AKVAWDAIRPEQYAKEGVFTVNGRLEGTQLTKLHVRVSAQTEQGANISDQWTGSELPLAFASDSNPSPD  
PVSNNVDKLI SYNQPANRWTNNRNTNPEASVGLFGDSGILSKRSVDNLSVGFHEDHGVGVPKSYVIE  
YYVGKTVPTAPKNPSFVGNEDHVFND SANWKPVTLKAPAQLKAGEMNHFSFDKVETAVRIRMVKADN  
KRGTSITEVQIFAKQVAAAKQGQTRI QVDGKDLANFNPDLDY YLESVDGKVPVAVTASVSNGLATVVP  
SVREGEPRVIAKAENG DILGEYRLHFTKDKSLLSHKPVA AVKQARLLQVGQALELPTKVPVYFTGKDG  
YETKDLTV EWEVPAENLT KAGQFTVRGRVLGSLNVAEITVRVTDKLGETLSDNPNYDENS NQAFASAT  
NDIDKNSHDRV DYLNDGDHSENRRWTNWSPTPSSNPEVSAGVIFRENGKIVERTVTQGVQFFADSGTD  
APSKLV LERYVGP EFVPTYYSNYQAYDADHPFNPNENWEAVPYRADKDIAAGDEINVT FKA I KAKAMR  
WRMERKADKSGVAMIEMTFLAPSEL PQESTQSKILVDGKELADFAENRQDYQITYKGQRPKVSVEENNQ  
VASTVVD SGEDSF PVLVRLVSESGKQVKEYRIHLTKEKPVSEKTVA AVQEDLPKIEFVEKDLAYKTVEK  
KDSTLYLGETRVEQEGKVGKERIFTAINPDGSKEEKLREVVVEVPTDRIVLVGTPKVAQEA KKPQVSEKA  
DTKPIDSSEASQTNKAQ

**SP054 nucleotide (SEQ ID NO:87)**

CTATCACTATGTAAATAAAGAGATTATTTCAACAAGAGCTAAAGATTTAATTCAGACAGGAAAGCCTGA  
CAGGAATGAAGTTGTATATGGTTTGGTGTATCAAAAAGATCAGTTGCCTCAAACAGGGACAGAA

**SP054 amino acid (SEQ ID NO:88)**

YHYVNKEIISQEAKDLIQTGKPD RNEVVYGLVYQKDQLPQTGTE

**SP055 nucleotide (SEQ ID NO:89)**

TGAGACTCCTCAATCAATAACAAATCAGGAGCAAGCTAGGACAGAAAACCAAGTAGTAGAGACAGAGGA  
AGCTCCAAAAGAAGAAGCACCTAAAACAGAAGAAAGTCCAAAGGAAGAACCAAAATCGGAGGTAAAACC  
TACTGACGACACCCTTCCTAAAGTAGAAGAGGGGAAAGAAGATTCAGCAGAACCAGCTCCAGTTGAAGA  
AGTAGGTGGAGAAGTTGAGTCAAAACCAGAGGAAAAAGTAGCAGTTAAGCCAGAAAGTCAACCATCAGA  
CAAACCAGCTGAGGAATCAAAAGTTGAACAAGCAGGTGAACCAGTCGCGCCAAGAGAAGACGAAAAGGC  
ACCAGTCGAGCCAGAAAAGCAACCAGAAGCTCCTGAAGAAGAGAAGGCTGTAGAGGAAACACCGAAACA  
AGAAGAGTCAACTCCAGATACCAAGGCTGAAGAACTGTAGAACCAAAAGAGGAGACTGTTAATCAATC  
TATTGAACAACCAAAAGTTGAAACGCCTGCTGTAGAAAAACAAACAGAACCAACAGAGGAACCAAAAGT  
TGAACAAGCAGGTGAACCAGTCGCGCCAAGAGAAGACGAACAGGCACCAACGGCACCAGTTGAGCCAGA  
AAAGCAACCAGAAGTTCTCTGAAGAAGAGAAGGCTGTAGAGGAAACACCGAAACCAGAAGATAAAATAAA  
GGGTATTGGTACTAAAGAACCAGTTGATAAAAGTGAGTTAAATAATCAAATTGATAAAGCTAGTTCACT  
TTCTCCTACTGATTAT

**SP055 amino acid (SEQ ID NO:90)**

ETPQSITNQEQARTENQVVETEEAPKEEAPKTEESPKKEPKSEVKPTDDTL PKVEEGKEDSAEPAPVEE  
VGGEVESKPEEKVAVKPESQPSDKPAEESKVEQAGEPVAPREDEKAPVEPEKQPEAPEEEKAVEETPKQ  
EESTPDTKAETVEPKEETVNQSI EQPKVETPAVEKQTEPTEEPKVEQAGEPVAPREDEQAPTAPVEPE  
KQPEVP EEEKAVEETPKPEDKIKGIGTKPEVDKSELNNQIDKASSVSPTDY

**SP056 nucleotide (SEQ ID NO:91)**

GGATGCTCAAGAAACTGCGGGAGTTCACTATAAATATGTGGCAGATTGAGAGCTATCATCAGAAGAAAA  
GAAGCAGCTTGTCTATGATATTCCGACATACGTGGAGAATGATGATGAACTTATTATCTTGTATTATAA  
GTAAATTCTCAAAATCAACTGGCGGAATTGCCAAATACTGGAAGCAAGAATGAGAGGCAA

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Table 1

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## SP056 amino acid (SEQ ID NO:92)

DAQETAGVHYKYVADSELSSEEKKQLVYDIPTYVENDDETYLVYKLNSQNQLAELPNTGSKNERQ

## SP057 nucleotide (SEQ ID NO:93)

CGACAAAGGTGAGACTGAGGTTCAACCAGAGTCGCCAGATACTGTGGTAAGTGATAAAGGTGAACCAGA  
GCAGGTAGCACCCTTCCAGAATATAAGGGTAATATTGAGCAAGTAAAACCTGAAACTCCGGTTGAGAA  
GACCAAAGAACAAGGTCCAGAAAAAAGTGAAGAAGTTCAGTAAAAACCAACAGAAAGAACACCAGTAAA  
TCCAAATGAAGGTACTACAGAAGGAACCTCAATTCAAGAAGCAGAAAAATCCAGTTCAACCTGCAGAAGA  
ATCAACAACGAATTCAGAGAAAGTATCACCAGATACATCTAGCAAAAAATACTGGGGAAGTGTCCAGTAA  
TCCTAGTGATTTCGACAACCTCAGTTGGAGAATCAAATAAACCCAGAACATAATGACTCTAAAAATGAAAA  
TTCAGAAAAAAGTGTAGAAGAAGTTCAGTAAATCCAAATGAAGGCACAGTAGAAGGTACCTCAAATCA  
AGAAACAGAAAAACAGTTCAACCTGCAGAGAAACACAAACAACTCTGGGAAAAATAGCTAACGAAAA  
TACTGGAGAAGTATCCAATAAACCTAGTGATTCAAACACCAGTTGAAGAATCAAATCAACCAGAAAA  
AAACGGAATGCAACAAAACCCAGAAAATTCAGGTAATACAACATCAGAGAAATGGACAAACAGAACGAGA  
ACCATCAAACGGAAATTCAACTGAGGATGTTTCAACCGAATCAAACACATCCAATTCAAATGGAAACGA  
AGAAATTAAACAAGAAAATGAAGTACACCTGATAAAAAAGGTAGAAGAACCAGAGAAAACACTTGAATT  
AAGAAAT

## SP057 amino acid (SEQ ID NO:94)

DKGETEVQPESPDTVVSDKGEPEQVAPLPEYKGNIEQVKPETPVEKTKEQGPEKTEEVVVKPTEETPVN  
PNEGTTGETSIQEAENPVQPAEESTTNSEKVSPTDSSKNTGEVSSNPSTSTSVGESNKPENHDSKNEN  
SEKTVEEVPVNPNEGTVEGTSNQETEKPVQPAEETQTNNGKIANENTGEVSNKPSDSKPPVEESNQPEK  
NGTATKPENSGNTTSENGQTEPEPSNGNSTEDVSTESNTSNSNGNEEIKQENELDPDKKVEEPEKTLEL  
RN

## SP058 nucleotide (SEQ ID NO:95)

AAATCAATTGGTAGCACAAAGATCCAAAAGCACAAAGATAGCACTAACTGACTGCTGAAAAATCAACTGT  
TAAAGCACCTGCTCAAAGAGTAGATGTAAAAGATATAACTCATTAAACAGATGAAGAAAAAGTTAAGGT  
TGCTATTTTACAAGCAAATGGTTTCAGCATTAGACGGAGCGACAATCAATGTAGCTGGAGATGGTACAGC  
ACAATCACATTCCCAGATGGTTTCAGTAGTGACGATTCTAGGAAAAGATACAGTTCAACAATCTGCGAA  
AGGTGAATCTGTAACCTCAAGAAGCTACACCAGAGTATAAGCTAGAAAATACACCAGGTGGAGATAGGG  
AGGCAATTCAGAAAGCTCAGATGCTAATGCGAATGAAGGCGGTGGTAGCCAGGCGGGTGGATCAGCTCA  
CACAGGTTTCAGAAACTCAGCTCAATCACAAGCTTCTAAGCAATTAGCTACTGAAAAAGAATCAGCTAA  
AAATGCCATTGAAAAAGCAGCCAAGGACAAGCAGGATGAAATCAAAGGCGCACCGCTTTCTGATAAAGA  
AAAAGCAGAACTTTTAGCAAGAGTGGAAGCAGAAAAACAAGCAGCTCTCAAAGAGATTGAAAATGCGAA  
AACTATGGAAGATGTGAAGGAAGCAGAAACGATTGGAGTGCAAGCCATTGCCATGGTTACAGTTCCTAA  
GAGACCAGTGGCTCCTAAT

## SP058 amino acid (SEQ ID NO:96)

NQLVAQDPKAQDSTKLTAEKSTVKAPAQRVDVKDITHLTDEEKVKVAILQANGSALDGATINVAGDGTA  
TITFPDGSVVTILGKDTVQQSAGGESVTQEATPEYKLENTPGGDKGNGTGSSDANANEGGGSQAGGSAH  
TGSQNSAQSQASKQLATEKESAKNAIEKAADKQDEIKGAPLSDEKAELLARVEAEKQAALKEIENAK  
TMEDVKEAETIGVQAIAMVTVPKRPVAPN

## SP059 nucleotide (SEQ ID NO:97)

CAAACAGTCAGCTTCAGGAACGATTGAGGTGATTTACAGAGAAAATGGCTCTGGGACACGGGGTGCCTT  
CACAGAAATCACAGGGATTCTCAAAAAAGACGGTGATAAAAAAATTGACAACACTGCCAAAACAGCTGT  
GATTCAAAATAGTACAGAAGGTGTTCTCTCAGCAGTTCAAGGGAATGCTAATGCTATCGGCTACATCTC  
CTTGGGATCTTTAACGAAATCTGTCAAGGCTTTAGAGATTGATGGTGTCAAGGCTAGTCGAGACACAGT  
TTTAGATTGGTGAATACCCCTCTTCAACGTCCTTCAACATTGTTTGGTCTTCTAATCTTTCCAAGCTAGG  
TCAAGATTTTATCAGCTTTATCCACTCCAAACAAGGTCAACAAGTGGTCACAGATAATAAATTTATTGA  
AGCTAAAACCGAAACCACGGAATATACAAGCCAACACTTATCAGGCAAGTTGTCTGTTGTAGGTTCCAC  
TTCAGTATCTTCTTTAATGAAAAAATTAGCAGAAGCTTATAAAAAAGAAAATCCAGAAGTTACGATTGA  
TATTACCTCTAATGGGTCTTCAGCAGGTATTACCGCTGTTAAGGAGAAAACCGCTGATATTGGTATGGT  
TTCTAGGGAATTAACCTCTGAAGAAGGTAAAGAGTCTCACCCATGATGCTATTGCTTTAGACGGTATTGC  
TGTTGTGGTCAATAATGACAATAAGGCAAGCCAAGTCAGTATGGCTGAACTTGCAGACGTTTTTAGTGG  
CAAATTAACCACCTGGGACAAGATTAAA

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Table 1

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## SP059 amino acid (SEQ ID NO:98)

KQSASGTIEVISRENGSGTRGAFTEITGILKKDGDKKIDNTAKTAVIQNSTEGVLSAVQGNANAIGYIS  
LGS�TKSVKALEIDGVKASRDITVLDGEYPLQRPFNIVWSSNLSKLGQDFISFIHSKQGGQVVDNKFIE  
AKTETTEYTSQHLSGKLSVVGSTSVSSLMKLAAYKKENPEVTIDITSNGSSAGITAVKEKTADIGMV  
SRELTPEEGKSLTHDAIALDGIADVNNNDNKASQVSMAELADVFSGLKTTWDKIK

## SP060 nucleotide (SEQ ID NO:99)

ATTTCGATGATGCGGATGAAAAGATGACCCGTGATGAAATTGCCTATATGCTGACAAATAGTGAAGAAAC  
ATTGGATGCTGATGAGATTGAGATGCTACAAGGTGTCTTTTCGCTCGATGAACATGATGGCACGAGAGGT  
TATGGTTCTCTCGAACGGATGCCCTTTATGGTGGATATTCAGGATGATAGTCAAGCCATTATCCAAAGTAT  
TTTAAACAAAATTATTCTCGTATCCCGGTTTATGATGGGGATAAGGACAATGTAATTGGAATCATTCA  
CACCAAGAGTCTCCTTAAGGCAGGCTTTGTGGACGGTTTTGACAATATTGTTTGAAGAGAATTTTACA  
AGATCCACTTTTTGTACCTGAAACTATTTTTGTGGATGACTTGCTAAAAGAACTGCGAAATACCCAAAG  
ACAAATG

## SP060 amino acid (SEQ ID NO:100)

FDDADEKMTREIAYMLTNSEETLDADEIEMLQGVFSLDELMAREVMVPRTDAFMVDIQDDSQAI IQSI  
LKQNYSRIPVYDGDKNVIGI IHTKSLKAGFVDGFDNIVWKRLQDPLFVPETIFVDDLKELRNTQR  
QM

## SP062 nucleotide (SEQ ID NO:101)

GGAGAGTCGATCAAAAGTAGATGAAGCTGTGTCTAAGTTTGAAAAGGACTCATCTTCTTCGTCAAGTTC  
AGACTCTTCCACTAAACCGGAAGCTTCAGATACAGCGAAGCCAAACAAGCCGACAGAACCAGGAGAAAA  
GGTAGCAGAAGCTAAGAAGAAGGTTGAAGAAGCTGAGAAAAAGCCAAGGATCAAAAAGAAGAAGATCG  
TCGTAAC TACCAACCATTAAC TACAAAACGCTTGAACCTGAAATTGCTGAGTCCGATGTGGAAGTTAA  
AAAAGCGGAGCTTGAAC TAGTAAAAGTGAAGCTAACGAACCTCGAGACGAGCAA

## SP062 amino acid (SEQ ID NO:102)

ESRSKVDEAVSKFEKDSSSSSSSDSSTKPEASDTAKPNKPTEPGEKVAEAKKKVEEA EKKAKDQKEEDR  
RNYPTITYKTLELEIAESDVEVKAELELVKVKANEPRDEQ

## SP063 nucleotide (SEQ ID NO:103)

ATGGACAACAGGAACTGGGACGAGGTTATATCTGGTAAGATTGACAAGTACAAAGATCCAGATATTCC  
AACAGTTGAATCACAAGAAGTTACGTCAGACTCTAGTGATAAAGAAATAACGGTAAGGTATGACCGTTT  
ATCAACACCAGAAAAACCAATCCCAACCAATCCAGAGCATCCAAGTGTTCGACACCAAACCCAGA  
ACTACCAAATCAAGAGACTCCAACACCAGATAAACCAACTCCAGAACCGGTACTCCAAAACTGAAAC  
TCCAGTGAATCCAGACCCAGAAGTTCGACTTATGAGACAGGTAAGAGAGAGGAATTGCCAAACACAGG  
TACAGAAGCTAAT

## SP063 amino acid (SEQ ID NO:104)

WTTGNWDEVISGKIDKYKDPDIPTVESQEVTSDDSDKEITVRYDRLSTPEKPI PQPNPEHPSVPTPNPE  
LPNQETPTPDKPTPEPGTPKTETPVNPDPEVPTYETGKREELPNTGTAN

## SP064 nucleotide (SEQ ID NO:105)

CGATGGGCTCAATCCAACCCAGGTCAAGTCTTACCTGAAGAGACATCGGGAACGAAAGAGGGTGACTT  
ATCAGAAAAACCAGGAGACACCGTTCTCACTCAAGCGAAACCTGAGGGCGTTACTGGAAATACGAATTC  
ACTTCCGACACCTACAGAAAGAACTGAAGTGAGCGAGGAAACAAGCCCTTCTAGTCTGGATACACTTTT  
TGAAAAAGATGAAGAAGCTCAAAAAATCCAGAGCTAACAGATGTCTTAAAAGAACTGTAGATACAGC  
TGATGTGGATGGGACACAAGCAAGTCCAGCAGAACTACTCCTGAACAAGTAAAAGGTGGAGTGAAAGA  
AAATACAAAAGACAGCATCGATGTTCTGTCTTATCTTGAAAAAGCTGAAGGGAAAGGTCCTTTTAC  
TGCCGGTGTAACCAAGTAATTCCTTATGAACTATTCGCTGGTGATGGTATGTTAACTCGTCTATTACT  
AAAAGCTTCGGATAATGCTCCTTGGTCTGACAATGGTACTGCTAAAAATCCTGCTTTACCTCCTCTTGA  
AGGATTAACAAAAGGGAAATACTTCTATGAAGTAGACTTAAATGGCAATACTGTTGGTAAACAAGGTCA  
AGCTTTAATTGATCAACTTCGCGCTAATGGTACTCAAACCTATAAAGCTACTGTTAAAGTTTACGGAAA  
TAAAGACGGTAAAGCTGACTTGACTAATCTAGTTGCTACTAAAAATGTAGACATCAACATCAATGGATT  
AGTTGCTAAAGAAACAGTTCAAAAAGCCGTTGCAGACAACGTTAAAGACAGTATCGATGTTCCAGCAGC  
CTACCTAGAAAAAGCCAAGGGTGAAGGTCCATTACAGCAGGTGTCAACCATGTGATTCCATACGAAC  
CTTCGACAGGTGATGGCATGTTGACTCGTCTCTTGCTCAAGGCATCTGACAAGGCACCATGGTCAGATAA

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Table 1

CGGCGACGCTAAAAACCCAGCCCTATCTCCACTAGGCGAAAAACGTGAAGACCAAAGGTCAATACTTCTA  
TCAANTAGCCTTGGACGGAAATGTAGCTGGCAAAGAAAAACAAGCGCTCATTGACCAGTTCGGAGCAA  
NGGTACTCAAACCTTACAGCGCTACAGTCAATGTCTATGGTAACAAAGACGGTAAACCAGACTTGGACAA  
CATCGTAGCAACTAAAAAAGTCACTATTAACATAAACGGTTAATTTCTAAAGAAACAGTTCAAAAAGC  
CGTTGCAGACAACGTTAANGACAGTATCGATGTTCCAGCAGCCTACCTAGAAAAAGCCAAGGGTGAAGG  
TCCATTACAGCAGGTGTCAACCATGTGATTCCATACGAACCTCTTCGCAGGTGATGGTATGTTGACTCG  
TCTCTTGCTCAAGGCATCTGACAAGGCACCATGGTCAGATAACGGNGACGCTAAAAACCCAGCNCATATC  
TCCACTAGGTGAAAAACGTGAAGACCAAAGGTCAATACTTCTATCAANTAGCCTTGGACGGAAATGTAGC  
TGGCAAAGAAAAACAAGCGCTCATTGACCAGTTCGGAGCAAACGGTACTCAAACCTTACAGCGCTACAGT  
CAATGTCTATGGTAACAAAGACGGTAAACCAGACTTGGACAACATCGTAGCAACTAAAAAAGTCACTAT  
TAAGATAAATGTTAAAGAAACATCAGACACAGCAAATGGTTCATTATCACCTTCTAACTCTGGTTCTGG  
CGTGACTCCGATGAATCACAATCATGCTACAGGTACTACAGATAGCATGCCTGCTGACACCATGACAAG  
TTCTACCAACACGATGGCAGGTGAAAACATGGCTGCTTCTGCTAACAAGATGTCTGATACGATGATGTC  
AGAGGATAAAGCTATG

**SP064 amino acid (SEQ ID NO:106)**

DGLNPTPGQVLPEETSGTKEGDLSEKPGDVTLTQAKPEGVTGNTNSLPTPTERTEVSEETSPSSLDTLF  
EKDEEAQKNPELTDVLKETVDTADVDGTQASPAETTPAQVKGKVKENTKDSIDVPAAYLEKAEGKGPFT  
AGVNQVI PYELFAGDGMLTRLRLKASDNAPWSDNGTAKNPALPLEGLTKGKYFYEVDLNGNTVKGQGG  
ALIDQLRANGTQTYKATVKVYGNKDGKADLTNLVATKNVDININGLVAKETVQKAVADNVKDSIDVPA  
YLEKAKGEGPFTAGVNHVI PYELFAGDGMLTRLRLKASDKAPWSDNGDAKNPALSPLGENVKTKGQYFY  
QXALDGNVAGKEKQALIDQFRAXGTQYTSATVNVYGNKDGKPDLDNIVATKKVTININGLISKETVQKA  
VADNVXDSIDVPAAYLEKAKGEGPFTAGVNHVI PYELFAGDGMLTRLRLKASDKAPWSDNGDAKNPALS  
PLGENVKTKGQYFYQXALDGNVAGKEKQALIDQFRANGTQYTSATVNVYGNKDGKPDLDNIVATKKVTI  
KINVKETSDTANGSLSPNSGSGVT PMNHNHATGTTDSMPADTMTSSTNTMAGENMAASANKMSDTMMS  
EDKAM

**SP065 nucleotide (SEQ ID NO:107)**

TTCCAATCAAAAACAGGCAGATGGTAAACTCAATATCGTGACAACCTTTTACCCTGTCTATGARTTTAC  
CAAGCAAGTCGCAGGAGATACGGCTAATGTAGAACTCCTAATCGGTGCTGGGACAGAACCTCATGAATA  
CGAACCATCTGCCAAGGCAGTTGCCAAAATCCAAGATGCAGATACCTTCGTTTATGAAAATGAAAACAT  
GGAAACATGGGTACCTAAATTGCTAGATACCTTGGATAAGAAAAAAGTGAAAACCATCAAGGCGACAGG  
CGATATGTTGCTCTTGCCAGGTGGCGAGGAAGAAGAGGGAGACCATGACCATGGAGAAGAAGGTCTATCA  
CCATGAGTTTGACCCCATGTTTGGTTATCACCAAGTTCGTGCCATTAACCTAGTAGAGCACCATCCGCG  
ACACTTGTGACGAGATTATCCTGATAAAAAAGAGACCTTTGAGAAGAATGCAGCTGCCTATATCGAAAA  
ATTGCAAGCCTTGGATAAGGCTTACGCAGAAGGTTGTCTCAAGCAAACAAAAGAGCTTTGTGACTCA  
ACACGCAgCCTTTAACTATCTTGCCTTGGACTATGGGACTC

**SP065 amino acid (SEQ ID NO:108)**

SNQKQADGKLNIVTTFYPVYEFTKQVAGDTANVELLIGAGTEPHEYEPSAKAVAKIQDADTFVYENENM  
ETWVPKLLDLDLKKVKTIKATGDMLLLPGGEEEGDHDHGEEGHHHEFDPHVWLSVPVRAIKLVEHHP  
HLSADYPDKKETFEKNAAAYIEKLQALDKAYAEGLSQAKQKSFVTQHAAFNLYLALDYG

**SP067 nucleotide (SEQ ID NO:109)**

TATCACAGGATCGAACGGTAAGACAACCACAACGACTATGATTGGGGAAGTTTTGACTGCTGCTGGCCA  
ACATGGTCTTTTATCAGGGAATATCGGCTATCCAGCTAGTCAGGTGCTCAAATAGCATCAGATAAGGA  
CACGCTTGTTATGGAACCTTTCTTCTTTCCAACCTCATGGGTGTTCAAGAATTCCATCCAGAGATTGCGGT  
TATTACCAACCTCATGCCAACTCATATCGACTACCATGGGTCAATTTTCGGAATATGTAGCAGCCAAGTG  
GAATATCCAGAACAAGATGACAGCAGCTGATTTCTTGTCTTGAACCTTTAATCAAGACTTGGCAAAAGA  
CTTGACTTCCAAGACAGAAGCCACTGTTGTACCATTTTCAACACTTGAAAAGGTTGATGGAGCTTATCT  
GGAAGATGGTCAACTCTACTTCCGTGGTGAAGTAGTCATGGCAGCGAATGAAATCGGTGTTCCAGGTAG  
CCACAATGTGGAAAATGCCCTTGGGACTATTGCTGTAGCCAAGCTTCGTGATGTGGACAATCAAACCAT  
CAAGGAAACTCTTTTACGCTTCGGTGGTGTCAAACACCGTCTCCAGTTTGTGGATGACATCAAGGGTGT  
TAAATTCTATAACGACAGTAAATCAACTAATATCTTGGCTACTCAAAAAGCCTTGTGAGATTGACAA  
CAGCAAGGTGCTTGTGATTGCAGGTGGTTTGGACCGTGGCAATGAGTTTGACGAATTGGTGCCAGACAT  
TACTGGACTCAAGAAGATGGTCATCCTGGGTCAATCTGCAGAACGTGTCAAACGGGCAGCAGACAAGGC  
TGGTGTGCTTATGTGGAGGCGACAGATATTGCAGATGCGACCCGCAAGGCCTATGAGCTTGGGACTCA

Table 1

AGGAGATGTGGTCTCTCTTAGTCCTGCCAATGCTAGCTGGGATATGTATGCTAACTTTGAAGTACGTGG  
CGACCTCTTTATCGACACAGTAGCGGAGTTAAAAGAA

**SP067 amino acid (SEQ ID NO:110)**

GITGSNGKTTTTTMMIGEVLTAAGQHGLLSGNIGYPASQVAQIASDKDTLVMELSSFQLMGVQEFHPEIA  
VITNLMPTHIDYHGSFSEYVAAKWNIQNKMTAADFLVLNFNQDLAKDLTSKTEATVVPFSTLEKVDGAY  
LEDGQLYFRGEVMAANEIGVPGSHNVENALATIAVAKLRDVDNQTIKETLSAFGGVKHRLQFVDDIKG  
VKFYNDKSTNILATQKALSGFDNSKVLIAGGLDRGNEFDELVPDITGLKKMVILGQSAERVKRAADK  
AGVAYVEATDIADATRKAYELATQGDVLLSPANASWDMYANFEVRGDLFIDTVAELKE

**SP068 nucleotide (SEQ ID NO:111)**

AAGTTCATCGAAGATGGTTGGGAAGTCCACTATATCGGGGACAAGTGTGGTATCGAACACCAAGAAATC  
CTTAAGTCAGGTTTGGATGTCACCTTCCATTCTATTGCGACTGGAAAATTGCGTCGCTATTTCTCTTGG  
CAAAATATGCTGGACGCTCTCAAAGTTGGTTGGGAATTGTCCAATCGCTCTTTATCATGTTGCGACTG  
CGTCCACAGACCCCTTTTTTCAAAGGGGGGCTTTGTCTCAGTACCGCTGTTATCGCTGCGCGTGTGTCA  
GGAGTGCCTGTCTTTATTACGAATCTGACCTGTCTATGGGCTTGCCAATAAAATCGCCTATAAATTT  
CGGACTAAGATGTATTCAACCTTTGAACAAGCTTCGAGTTTGGCTAAGGTTGAGCATGTGGGAGCGG

**SP068 amino acid (SEQ ID NO:112)**

SSSKMVGKSTISGTSVVSNTKKSLSQVWMSPIILLRLENCVAISLGKICWTSSKLVGELSNRSLSCDCD  
VHRPFFQRGALSQYRLLSLRVCQECLSLFTNLTLCLWAWPIKSPINLRLRCIQPLNKLRLVWRLSMWER

**SP069 nucleotide (SEQ ID NO:113)**

ATCGCTAGCTAGTGAAATGCAAGAAAGTACACGTAAATTCAGGTTACTGCTGACCTAACAGATGCCGG  
TGTTGGAACGATTGAAGTTCCTTTGAGCATTGAAGATTTACCCAATGGGCTGACCGCTGTGGCGACTCC  
GCAAAAAATTACAGTCAAGATTGGTAAGAAGGCTACAAGGATAAGGTAAGATTGTACCAGAGATTGA  
CCCTAGTCAAATGTATGATGTCGGGTACAATTTGAAAATGTCTCATGGTGTGAGATAAAGAAGTGTCTATTAC  
GAGTGACCAAGAGACATTGGATAGAATTGATAAGATTATCGCTGTTTTGCCAACTAGCGAACGTATAAC  
AGGTAATTACAGTGGTTTCAGTACCTTTGCAGGCAATCGACCGCAATGGTGTGTCTTACCGGCAGTTAT  
CACTCCGTTTGATACAATAATGAAGGTGACTACAAAACAGTAGCACCAAGTTCAAGCACATCAAATTC  
AAGTACAAGCAGTTTCATCGGAGACATCTTCGTCAACGAAAGCAACTAGTTCAAAAACGAAT

**SP069 amino acid (SEQ ID NO:114)**

SLASEMQESTRKFKVTADLTDAVGVTIEVPLSIEDLPNGLTAVATPQKITVKIGKKAQKDKVKIVPEID  
PSQIDSRVQIENVMSDKEVSITSDQETLDRIDKIIAVLPTSERITGNYSVSVPLQAI DRNGVVLPAVI  
TPFDTIMKVTTKPVAPSSSTSNSSTSSSSETSSSTKATSSSKTN

**SP070 nucleotide (SEQ ID NO:115)**

GCACCAGATGGGGCACAAGGTTTCAGGGATCAGATGTTGAAAAGTACTACTTTACCCAACGCGGTCTTGA  
GCAGGCAGGAATTACCATTCTTCTTTTGATGAAAAAATCTAGACGGTGATATGGAATTTATCGCTGG  
AAATGCCTTTTCGTCCAGATAACAACGTCGAAATTGCCTATGCGGACCAAAATGGTATCAGCTACAAACG  
TTACCATGAGTTTCTAGGTAGCTTTATGCGTGACTTTGTTAGCATGGGAGTAGCAGGACACATGGAAA  
AACTTCAACGACAGGTATGTTGTCTCATGTCTTGTCTCACATTACAGATACCAGCTTCTTGATTGGAGA  
TGGGACAGGTCGTGGTTTCGGCCAATGCCAAATATTTGTCTTTGAATCTGACGAATATGAGCGTCACTT  
CATGCCTTACCACCCAGAATACTCTATTATCACCAACATTGACTTTGACCATCCAGATTATTTTACAAG  
TCTCGAGGATGTTTTTAATGCCTTTAACGACTATGCCAAACAAATCACCAAGGGTCTTTTTGTCTATGG  
TGAAGATGCTGAATTGCGTAAGATTACGTCTGATGCACCAATTTATTATTATGGTTTTGAAGCTGAAGG  
CAATGACTTTGTAGCTAGTGATCTTCTTCGTTCAATAACTGGTTCAACCTTCACCGTTCAATTTCCGTGG  
ACAAAACCTTGGGGCAATTCCACATTCCAACCTTTGGTCGTCACAATATCATGAATGCGACAGCCGTTAT  
TGGTCTTCTTTACACAGCAGGATTTGATTTGAACTTGGTTCGTCGAGCACTTGAAAACATTTGCCGGTGT  
TAAACGTCGTTTCACTGAGAAAATTGTCAATGATACAGTGATTATCGATGACTTTGCCCACCATCCAAC  
AGAAATTATTGCGACCTTGGATGCGGCTCGTCAGAAATACCCAAGCAAGGAAATTGTAGCAGTCTTTCA  
ACCGCATACCTTTACAAGAACCATTGCCTTGTGGACGACTTTGCCCATGCTTTAAACCAAGCAGATGC  
TGTTTATCTAGCGCAAATTTATGGCTCGGCTCGTGAAGTAGATCATGGTGACGTTAAGGTAGAAGACCT  
AGCCAACAAAATCAACAAAAAACCAAGTGATTACTGTTGAAAATGTTTCTCCACTCCTAGACCATGA  
CAATGCTGTTTACGTCTTTATGGGAGCAGGAGACATCCAAACCTATGAATACTCATTGAGCGTCTCTT  
GTCTAACTTGACAAGCAATGTTCAA

Table 1

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## SP070 amino acid (SEQ ID NO:116)

HQMGHKVQGS DVEKYYFTQ RGLEQAGITILPFDEK NLDGDM EIIAGNAFRPDNNVEIAYADQNGISYKR  
YHEFLGSFMRDFVSMGVAGAHGKTSTTGMLSHVLSHITDTSFLIGDGTGRGSANAKYFVFESDEYERHF  
MPYHPEYSIITNIDFDHPDYFTSLEDVFNAFNDYAKQITKGLFVYGEDAELRKITS DAPIYYYGFEEAG  
NDFVASDLLRSITGSTFTVHFRGQNLGQFHIPTFGRHNIMNATAVIGLLYTAGFDLNLVREHLKTFAGV  
KRRFTEKIVNDTVIIDDFAHHPTEIIATLDAARQKYPskeIVAVFQPHFTFRTIALLDFAHALNQADA  
VYLAQIYGSAREVDHGDVKVEDLAN KINKKHQVITVENVSPLLDH DNAVYVFMGAGDIQTYEYSFERLL  
SNLTSNVQ

## SP071 nucleotide (SEQ ID NO:117)

TTTTAACCCAACTGTTGGTACTTTTCTTTTACTGCAGGATTGAGCTTGTAGTTTTATTGGTTTCTAA  
AAGGGAAAATGGAAAGAAACGACTTGTTTCATTTTCTGCTGTGACTAGCATGGGAGTTCAATTGTTGCC  
GGCCAGTGCTTTTGGGTTGACCAGCCAGATTTTATCTGCCTATAATAGTCAGCTTTCTATCGGAGTCGG  
GGAACATTTAGCAGAGCCTCTGAAAATCGAAGGTTATCAATATATTGGTTATATCAAACTAAGAAACA  
GGATAATACAGAGCTTTCAAGGACAGTTGATGGGAAAATACTCTGCTCAAAGAGATAGTCAACCAAACTC  
TACAAAACATCAGATGTAGTTTCATTTCAGCTGATTTAGAATGGAACCAAGGACAGGGGAAGGTTAGTTT  
ACAAGGTGAAGCATCAGGGGATGATGGACTTTTCAGAAAAATCTTCTATAGCAGCAGACAATCTATCTTC  
TAATGATTTCATTTCGCAAGTCAAGTTGAGCAGAATCCGGATCACAAAGGAGAATCTGTAGTTTCGACCAAC  
AGTGCCAGAACAAAGGAAATCCTGTGTCTGCTACAACGGTGCAGAGTGCAGGAAGAGGAAGTATTGGCGAC  
GACAAATGATCGACCAGAGTATAAACTTCCATTGGAAACCAAAGGCACGCAAGAACCCGGTCATGAGGG  
TGAAGCCGCAGTCCGTGAAGACTTACCAGTCTACACTAAGCCACTAGAAACCAAAGGTACACAAGGACC  
CGGACATGAAGGTGAAGCTGCAGTTCGCGAGGAAGAACCAGCTTACACAGAACCGTTAGCAACGAAAGG  
CACGCAAGAGCCAGGTTCATGAGGGCAAAGCTACAGTCCGCGAAGAGACTCTAGAGTACACGGAACCGGT  
AGCGACAAAAGGCACACAAGAACCCGAACATGAGGGCGAaCGGsCAGTAGAAGAAGAATTCGGGCTTT  
AGAGGTCACTACACGAAATAGAACGGAAATCCAGAATATTCCTTATACAACAGAAGAATTCAGGATCC  
AACACTTCTGAAAAATCGTCGTAAGATTGAACGACAAGGGCAAGCAGGGACACGTACAATTCAATATGA  
AGACTACATCGTAAATGGTAATGTCTGTAGAACTAAAGAAGTGTACGAACTGAAGTAGCTCCGGTCAA  
CGAAGTCGTTAAAGTAGGAACACTTGTGAAAGTTAAACCTACAGTAGAAATTACAACTTAACAAAAGT  
TGAGAACAAAAATCTATAACTGTAAGTTATAACTTAATAGACACTACCTCAGCATATGTTTCTGCAAA  
AACGCAAGTTTTTCATGGAGACAAGCTAGTTAAAGAGGTGGATATAGAAAATCCTGCCAAAGAGCAAGT  
AATATCAGGTTTTAGATTACTACACACCGTATACAGTTAAACACACCTAACCTTATAATTTGGGTGAAAA  
TAATGAGGAAAATACTGAAACATCAACTCAAGATTTCCAATTAGAGTATAAGAAAATAGAGATTAAAGA  
TATTGATTTCAGTAGAATTATACGGTAAAGAAAATGATCGTTATCGTAGATATTTAAGTCTAAGTGAAGC  
GCCGACTGATACGGCTAAATACTTTGTAAAGTGAAATCAGATCGCTTCAAAGAAATGTACCTACCTGT  
AAAATCTATTACAGAAAATACGGATGGAACGTATAAAGTGACGGTAGCCGTTGATCAACTTGTGCAAGA  
AGGTACAGACGGTTACAAAGATGATTACACATTTACTGTAGCTAAATCTAAAGCAGAGCAACCAGGAGT  
TTACACATCCTTTAAACAGCTGGTAACAGCCATGCAAAGCAATCTGTCTGGTGTCTATACATTGGCTTC  
AGATATGACCGCAGATGAGGTGAGCTTAGGCGATAAGCAGACAAGTTATCTCACAGGTGCATTTACAGG  
GAGCTTGATCGGTTCTGATGGAACAAAATCGTATGCCATTTATGATTTGAAGAAACCATTATTTGATAC  
ATTAATGGTGCTACAGTTAGAGATTTGGATATTTAAACTGTTTCTGCTGATAGTAAAGAAAATGTCTGC  
AGCGCTGGCGAAGGCAGCGAATAGCGCGAATATTAATAATGTTGCAGTAGAAGGAAAATCTCAGGTGC  
GAAATCTGTTGCGGGATTAGTAGCGAGCGCAACAAATACAGTGATAGAAAACAGCTCGTTTACAGGGAA  
ACTTATCGCAAATCACCAGGACAGTAATAAAAATGATACTGGAGGAATAGTAGGTAATATAACAGGAAA  
AGCTGGAGGGATAGTAGGTAGATTAGAAAATGGTGCATTGATATCTAATTCGGTTGCTACTGGGAGAAAT  
ACGAAATGGTCAAGGATATTCTAGAGTCGGAGGAATAGTAGGATCTACGTGGCAAACAGCTCGAGTAAA  
TAATGTTGTGAGTAACGTAGATGTTGGAGATGTTATGTTATCACCGGTGATCAATACGCAGCAGCAGA  
TGTGAAAAATGCAAGTACATCAGTTGATAATAGAAAAGCAGACAGATTGCTACAAAATTATCAAAAAGA  
CCAAATAGACGCGAAAGTTGCTGATTATGGAATCACAGTAACCTCTTGATGATACTGGGCAAGATTTAAA  
ACGTAATCTAAGAGAAGTTGATTATACAAGACTAAATAAAGCAGAAGCTGAAAGAAAAGTAGCTTATAG  
CAACATAGAAAACTGATGCCATTCTACAATAAAGACCTAGTAGTTCACTATGGTAACAAAGTAGCGAC  
AACAGATAAACTTTACACTACAGAATTGTTAGATGTTGTGCCGATGAAAGATGATGAAGTAGTAACGGA  
TATTAATAATAAGAAAAATTCAATAAATAAAGTTATGTTACATTTCAAAGATAATACAGTAGAATACCT  
AGATGTAACATTCAAAGAAAACCTCATAAACAGTCAAGTAATCGAATACAATGTTACAGGAAAAGAATA  
TATATTACACCAGAAGCATTTGTTTCAGACTATACAGCGATAACGAATAACGTACTAAGCGACTTGCA  
AAATGTAACACTTAAC

## SP071 amino acid (SEQ ID NO:118)

Table 1

FNPTVGTFLFTAGLSLLVLLVSKRENGKKRLVHFLLLTSMGVQLLPASAFGLTSQILSAYNSQLSIGVG  
EHLPEPLKIEGYQYIGYIKTKKQDNTELSRTVDGKYSAQRDSQPNSTKTSDDVHSADLEWNQGGKVS  
QGEASGDDGLSEKSSIAADNLSSNDSFASQVEQNPDPKHGESVVRPTVPEQGNPVSATTVQSAEEVLAT  
TNDREYKLPLETGKTQEPGHEGEAAVREDLPVYTKPLETKGTQGPGEHEGEAAVREEEPAYTEPLATKG  
TQEPGHEGKATVREETLEYTEPVATKGTQEPPEHEGERXVEEELPALEVTTNRNTEIQNIPTTTEEIQDP  
TLLKNRRKIERQGGAGTRTIQYEDYIVNGNVVETKEVSRTEVAPVNEVVKVGTLVKVKPTVEITNLTKV  
ENKKSITVSYNLIDTTSAYVSAKTQVFHGDGLVKEVDIENPAKEQVISGLDYTPYTVKTHLTYNLGEN  
NEENTETSTQDFQLEYKKIEIKDIDSVELYKENDRYRRYLSLSEAPDTAKYFVKVKSDFKEMYL PV  
KSITENTDGTYKVTVAVDQLVEEGTDGYKDDYTFTVAKSKAEQPGVYTSFKQLVTAMQSNLSGVYTLAS  
DMTADDEVSLGDKQTSYLTGAFTGSLIGSDGTSYAIYDLKKPLFDLTNGATVRDLDIKTVSADSKENVA  
ALAKAANSANINNVAVEGKISGAKSVAGLVASATNTVIENSSTFGKLIANHQDSNKNNDTGGIVGNITGN  
SSRVNKRVRDALISTNARNNNQTAGGIVGRLENGALISNSVATGEIRNGQGYSRVGGIVGSTWQNGRVN  
NVVSNVDVGDGYVITGDQYAAADVKNASTSVDNRKADRFATKLSKDQIDAKVADYGITVTLDDTGQDLK  
RNLREVDTYRLNKAERKVAYSNIEKLMPFYNKDLVVHYGNKVATTDKLYTTELLDVVPMKDDEVVTD  
INNKKNSINKVMLHFKDNTVEYLDVTFKENFINSQVIEYNVTGKEYIFTPEAFVSDYTAITNNVLSDLQ  
NVTLN

**SP072 nucleotide (SEQ ID NO:119)**

TTTTAACCCAACTGTTGGTACTTTTCCTTTTTACTGCAGGATTGAGCTTGTAGTTTTATTGGTTTCTAA  
AAGGGAAAATGGAAAGAAACGACTTGTTCATTTTCTGCTGTGACTAGCATGGGAGTTCAATTGTTGCC  
GGCCAGTGCTTTTGGGTTGACCAGCCAGATTTTATCTGCCTATAATAGTCAGCTTTCTATCGGAGTCGG  
GGAACATTTACCAGAGCCTCTGAAAATCGAAGGTTATCAATATATTGGTTATATCAAACTAAGAAACA  
GGATAATACAGAGCTTTCAAGGACAGTTGATGGGAAATACTCTGCTCAAAGAGATAGTCAACCAAATC  
TACAAAACATCAGATGTAGTTTATTGAGCTGATTTAGAATGGAACCAAGGACAGGGGAAGGTTAGTTT  
ACAAGGTGAAGCATCAGGGGATGATGGACTTTCAGAAAAATCTTCTATAGCAGCAGACAATCTATCTTC  
TAATGATTCAATCGCAAGTCAAGTTGAGCAGAATCCGGATCACAAAGGAGAATCTGTAGTTTCGACCAAC  
AGTGCCAGAACAAAGGAAATCCTGTGTCTGCTACAACCGTGCAGAGTGCAGGAGAGGAGTATGGCGAC  
GACAAATGATCAGCCAGAGATAAACTTCCATTGGAAACCAAAGGCACGCAAGAACCCGGTCATGAGGG  
TGAAGCCGCAGTCCGTGAAGACTTACCAGTCTACACTAAGCCACTAGAAACCAAAGGTACACAAGGACC  
CGGACATGAAGGTGAAGCTGCAGTTTCGCGAGGAAGAACCAGCTTACACAGAACCCTTAGCAACGAAAGG  
CACGCAAGAGCCAGGTTCATGAGGGCAAAGCTACAGTCCGCGAAGAGACTCTAGAGTACACGGAACCGGT  
AGCGCAAAAAGGCACACAAGAACCCGAACATGAGGGCGAaCGGsCAGTAGAAGAAGAATCTCCGGCTTT  
AGAGGTCACTACACGAAATAGAACGGAAATCCAGAATATTCCTTATACAACAGAAGAAATTCAGGATCC  
AACACTTCTGAAAAATCGTCGTAAGATTGAACGACAAGGGCAAGCAGGGACACGTACAATTCAATATGA  
AGACTACATCGTAAATGGTAATGTCTGTAGAACTAAAGAAGTGTACGAAGTGAAGTAGCTCCGGTCAA  
CGAAGTCGTTAAAGTAGGAACACTTGTGAAAGTTAAACCTACAGTAGAAATTACAACTTAACAAAAGT  
TGAGAACAAAAATCTATAACTGTAAGTTATAACTTAATAGACACTACCTCAGCATATGTTTCTGCAAA  
AACGCAAGTTTTCCATGGAGACAAGCTAGTTAAAGAGGTGGATATAGAAAATCCTGCCAAAGAGCAAGT  
AATATCAGGTTTATGATTACTACACACCGTATACAGTTAAACACACCTAATTTATAATTTGGGTGAAAA  
TAATGAGGAAAATACTGAAACATCAACTCAAGATTCCAATTAGAGTATAAGAAAATAGAGATTAAAGA  
TATTGATTCAGTAGAATTATACGGTAAAGAAAATGATCGTTATCGTAGA

**SP072 amino acid (SEQ ID NO:120)**

FNPTVGTFLFTAGLSLLVLLVSKRENGKKRLVHFLLLTSMGVQLLPASAFGLTSQILSAYNSQLSIGVG  
EHLPEPLKIEGYQYIGYIKTKKQDNTELSRTVDGKYSAQRDSQPNSTKTSDDVHSADLEWNQGGKVS  
QGEASGDDGLSEKSSIAADNLSSNDSFASQVEQNPDPKHGESVVRPTVPEQGNPVSATTVQSAEEVLAT  
TNDREYKLPLETGKTQEPGHEGEAAVREDLPVYTKPLETKGTQGPGEHEGEAAVREEEPAYTEPLATKG  
TQEPGHEGKATVREETLEYTEPVATKGTQEPPEHEGERXVEEELPALEVTTNRNTEIQNIPTTTEEIQDP  
TLLKNRRKIERQGGAGTRTIQYEDYIVNGNVVETKEVSRTEVAPVNEVVKVGTLVKVKPTVEITNLTKV  
ENKKSITVSYNLIDTTSAYVSAKTQVFHGDGLVKEVDIENPAKEQVISGLDYTPYTVKTHLTYNLGEN  
NEENTETSTQDFQLEYKKIEIKDIDSVELYKENDRYRR

**SP073 nucleotide (SEQ ID NO:121)**

TCGTAGATATTTAAGTCTAAGTGAAGCGCCGACTGATACGGCTAAATACTTTGTAAAAGTGAAATCAGA  
TCGCTTCAAAGAAATGTACCTACCTGTAAATCTATTACAGAAAATACGGATGGAACGTATAAAGTGAC  
GGTAGCCGTTGATCAACTTGTGCGAAGAAGGTACAGACGGTTACAAAGATGATTACACATTTACTGTAGC  
TAAATCTAAAGCAGAGCAACCAGGAGTTTACACATCCTTTAAACAGCTGGTAACAGCCATGCAAAGCAA  
TCTGTCTGGTGTCTATACATTGGCTTCAGATATGACCGCAGATGAGGTGAGCTTAGGCGATAAGCAGAC

Table 1

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AAGTTATCTCACAGGTGCATTTACAGGGAGCTTGATCGGTTCTGATGGAACAAAATCGTATGCCATTTA  
TGATTTGAAGAAACCATTATTTGATACATTAAATGGTGTACAGTTAGAGATTTGGATATTAAAACGT  
TTCTGCTGATAGTAAAGAAAATGTTCGAGCGCTGGCGAAGGCAGCGAATAGCGCGAATATTAATAATGT  
TGCAGTAGAAGGAAAAATCTCAGGTGCGAAATCTGTTGCGGGATTAGTAGCGAGCGCAACAAATACAGT  
GATAGAAAACAGCTCGTTTACAGGGAACTTATCGCAAAATCACCAGGACAGTAATAAAAATGATACTGG  
AGGAATAGTAGGTAATATAACAGGAAATAGTTTCGAGAGTTAATAAAGTTAGGGTAGATGCCTTAATCTC  
TACTAATGCACGCAATAATAACCAAAACAGCTGGAGGGATAGTAGGTAGATTAGAAAATGGTGCATTGAT  
ATCTAATTCGGTTGCTACTGGAGAAATACGAAATGGTCAAGGATATTCTAGAGTCGGAGGAATAGTAGG  
ATCTACGTGGCAAAACGGTCGAGTAAATAATGTTGTGAGTAACGTAGATGTTGGAGATGGTTATGTTAT  
CACCAGGTGATCAATACGCAGCAGCAGATGTGAAAAATGCAAGTACATCAGTTGATAATAGAAAAGCAGA  
CAGATTCGCTACAAAATTATCAAAAGACCAAATAGACGCGAAAGTTGCTGATTATGGAATCACAGTAAC  
TCTTGATGATACTGGGCAAGATTTAAACGTAATCTAAGAGAAGTTGATTATACAAGACTAAATAAAGC  
AGAAGCTGAAAGAAAAGTAGCTTTATGCAACATAGAAAAACTGATGCCATTCTACAATAAAGACCTAGT  
AGTTCACATATGGTAACAAAGTAGCGACAACAGATAAACTTTACACTACAGAATTGTTAGATGTTGTGCC  
GATGAAAGATGATGAAGTAGTAACGGATATTAATAATAAGAAAAATTCAATAAATAAAGTTATGTTACA  
TTTCAAAGATAATACAGTAGAATACCTAGATGTAACATTCAAAGAAAACCTCATAAACAGTCAAGTAAT  
CGAATACAATGTTACAGGAAAAGAATATATATTCACACCAGAAGCATTTGTTTCAGACTATACAGCGAT  
AACGAATAACGTACTAAGCGACTTGCAAAATGTAACACTTAAC

**SP073 amino acid (SEQ ID NO:122)**

RRYLSLSEAPDTAKYFVKVKSDFKEMYLVPKSI TENDGTYKVTVAVDQLVEEGTDGYKDDYTFTVA  
KSKAEQPGVYTSFKQLVTAMQSNLSGVYTLASDMTADDEVSLGDKQTSYLTGAFTGSLIGSDGTSYAIY  
DLKKPLFDTLNGATVRDLDIKTVSADSKENVAALAKAANSANINNVAVEGKISGAKSVAGLVSATNTV  
IENSSFTGKLIANHQDSNKNNDTGIVGNITGNSSRVNKRVDALISTNARNNNQTAGGIVGRLENGALI  
SNSVATGEIRNGQYSRVGGIVGSTWQNGRVNVMVSNVDVGDGYVITGDQYAADVKNASTSVDNRKAD  
RFATKLSKDQIDAKVADYGITVTLDDTGQDLKRNLRVVDYTRLNKAERKVAYSNIEKLMFPYKNDLV  
VHYGNKVATTDKLYTTELLDVVPMKDDEVVTDINNKKNSINKVMLHFKDNTVEYLDVTFKENFINSQVI  
EYNVTGKEYIFTPEAFVSDYTAITNNVLSDLQNVTLN

**SP074 nucleotide (SEQ ID NO:123)**

CTTTGGTTTTGAAGGAAGTAAGCGTGGACAATTTGCTGTAGAAGGAATCAATCAACTTCGTGAGCATGT  
AGACACTCTATTGATTATCTCAAACAACAATTTGCTTGAAATTGTTGATAAGAAAACACCGCTTTTGGGA  
GGCTCTTAGCGAAGCGGATAACGTTCTTCGTCAAGGTGTTCAAGGGATTACCGATTTGATTACCAATCC  
AGGATTGATTAACCTTGACTTTGCCGATGTGAAAACGGTAATGGCAAACAAAGGGAATGCTCTTATGGG  
TATTGGTATCGGTAGTGGAGAAGAACGTGTGGTAGAAGCGGCACGTAAGGCAATCTATTACCACTTCT  
TGAAACAACATTGACGGTGCTGAGGATGTTATCGTCAACGTTACTGGTGGTCTTGACTTAACCTTGAT  
TGAGGCAGAAGAGGCTTCACAAATTGTGAACAGGCAGCAGGTCAAGGAGTGAACATCTGGCTCGGTAC  
TTCAATTGATGAAAGTATGCGTGATGAAATTCGTGTAACAGTTGTTGCAACGGGTGTTCTGTCAGACCG  
CGTAGAAAAGGTTGTGGCTCCACAAGCTAGATCTGCTACTAACTACCGTGAGACAGTGAACACAGCTCA  
TTCACATGGCTTTGATCGTCATTTTGATATGGCAGAAACAGTTGAATTGCCAAAACAAAATCCACGTGCG  
TTTGGAAACCAACTCAGGCATCTGCTTTTGGTGATTGGGATCTTCGCCGTGAATCGATTGTTTCGTACAAC  
AGATTTCAGTCGTTTCTCCAGTCGAGCGCTTTGAAGCCCCAATTCACAAGATGAAGATGAATTGGATAC  
ACCTCCATTTTTTCAAAAATCGT

**SP074 amino acid (SEQ ID NO:124)**

FGFEGRKRGQFAVEGINQLREHVDTLIIISNNLLEIVDKKTPLEALSEADNVLRQGVQGITDLITNP  
GLINLDFADVKTVMANKGNALMGIGISGEERVVEAARKAIYSPLLETTIDGAEDVIVNVTGGLDLTLI  
EAEEASQIVNQAGQGVNIWLGTSIDESMRDEIRVTVVATGVRQDRVEKVVAPQARSATNYRETVPKPAH  
SHGFDRHFDMAETVELPKQNPRLLEPTQASAFGDWDLRRESIVRTTDSVVSVERFEAPISQDEDELDT  
PPFFKNR

**SP075 nucleotide (SEQ ID NO:125)**

CTACTACCTCTCGAGAGAAAGTGACCTAGAGGTGACCGTTTTTGACCATGAGCAAGGTCAAGCCACCAA  
GGCCGCAGCAGGAATTATCAGTCCTTGTTTTCCAAACGCCGTAATAAAGCCTGGTACAAGATGGCGCG  
CTTGGGGGCTGATTTTTATGTGGATTATAGCTGATTTAGAGAAATCAGGACAAGAAATCGACTTTTA  
CCAGCGTTCCGGGAGTCTTTCTCTTGAAAAGGATGAATCCAATTTGGAAGAAGTTTATCAACTGGCCCT  
CCAGCGCAGAGAAGAATCTCCETTATAGAGGCAATTAGCCATTCTGAACCAAGCCTCAGCTAATGAATT  
ATTCCTGGTTTTGCAGGGATTTGACCGCTGCTCTATGCTTCTGGTGGAGCGAGAGTAGATGGCCAAC

T022T012201

Table 1

TTTAGTGACTCGTTTGCTGGAAGTCAGTCATGTCAAGCTGGTCAAAGAAAAAGTGACTCTGACACCGTT  
AGCATCAGGCTACCAGATTGGTGAAGAGGAGTTTGGAGAGGTTATTTTGGCGACGGGAGCTTGGTTGGG  
GGACATGTTAGAGCCTTTAGGTTATGAAGTGGATGTCCGTCCTCAAAAAGGACAACCTACGAGATTATCA  
GCTTGCCCAAGACATGGAAGATTACCCTGTTGTCTATGCCAGAAGGGGAGTGGGATTTGATTCCCTTTGC  
AGGTGGGAAATTATCCTTAGGCGCTACCCACGAAAATGACATGGGATTTGATTGACGGTAGATGAAAC  
CTTGCTCCAACAAATGGAGGAGGCCACCTTGACTCACTATCTGATTTTGGCTGAAGCTACTTCAAAATC  
TGAGCGTGTGGAATCCGTGCCTACACCAGTGATTCTCTCCTTTCTTTGGGCAGGTGCCTGACTTAAC  
TGGTGTCTATGCAGCCAGTGGACTAGGTTTCATCAGGCCTCACAACCTGGTCTATCATTGGTTACCATCT  
AGCCCAACTGATCCAAGACAAGGAGTTGACCTTGGACCCTCTAAATTACCCAATTGAAAACCTATGTCAA  
ACGAGTAAAAAGCGAA

**SP075 amino acid (SEQ ID NO:126)**

YYLSRESLDLEVTVDHEQGQATKAAAGIISPWFSKRRNKAWYKMARLGADFYVDLLADLEKSGQEIDFY  
QRSGVFLKKDESNEELYQLALQRREESPLIGQLAILNQASANELFPGLQGFDRLLYASGGARVDGQL  
LVTRLLEVSHVKLVKEKVTLTPLASGYQIGEEFEQVILATGAWLGDMLEPLGYEVDVRPQKGQLRDYQ  
LAQDMEDYPVVMPEGEWDLIPFAGGKLSLGATHENDMGFDLTVDETLQMQMEEATLTHYLILAEATSKS  
ERVGIRAYTSDFSPFFGQVDPDLTGVYAASGLSSGLTTGPIIGYHLAQLIQDKELTLDPLNYPINIVK  
RVKSE

**SP076 nucleotide (SEQ ID NO:127)**

TAAGGTCAAAAGTCAGACCGCTAAGAAAGTGCTAGAAAAGATTGGAGCTGACTCGGTTATCTCGCCAGA  
GTATGAAATGGGGCAGTCTCTAGCACAGACCATTCTTTTCCATAATAGTGTTGATGTCTTTTCACTTGA  
TAAAAATGTGCTCTATCGTGGAGATGAAAATTCCTCAGTCTTGGGCAGGTCAAAGTCTGAGTAAATTAGA  
CCTCCGTGGCAAATACAATCTGAATATTTGGGTTTCCGAGAGCAGGAAAATCCCCATTGGATGTTGA  
ATTTGGACCAGATGACCTCTTGAAAGCAGATACCTATATTTTGGCAGTCATCAACAACCAGTATTTGGA  
TACCCTA

**SP076 amino acid (SEQ ID NO:128)**

KVKSQTAKKVKLEKIGADSVISPEYEMGQSLAQTLFHNSVDVFLDKNVSIVEMKIPQSWAGQSLSKLD  
LRGKYNLNLGFRQENSPLDVEFGPDDLLKADTYILAVINNQYLDL

**SP077 nucleotide (SEQ ID NO:129)**

TGACGGGTCTCAGGATCAGACTCAGGAAATCGCTGAGTGTTAGCTAGCAAGTATCCTAATATCGTTAG  
AGCCATCTATCAGGAAAATAAATGCCATGGCGGTGCGGTCAATCGTGGCTTGGTAGAGGCTTCTGGGCG  
CTATTTTAAAGTAGTTGACAGTGATGACTGGGTGGATCCTCGTGCCTACTTGAAAATCTTTGAAACTTG  
CAGGAACCTTGAGAGCAAAGGTCAAGAGGTGGATGTCTTTG

**SP077 amino acid (SEQ ID NO:130)**

DGSQDQTQEIAECLASKYPNIVRAIYQENKCHGGAVNRGLVEASGRYFKVVDSDDWVDPRAYLKILETC  
RNLRAKVKRWMSL

**SP078 nucleotide (SEQ ID NO:131)**

TAGAGGCTTTGCCAAATGGTGGGAAGGGCACGAGCGTCGAAAAGAGGAACGCTTTGTCAAACAAGAAGA  
AAAAGCTCGCCAAAAGGCTGAGAAAGAGGCTAGATTAGAACAAGAAGAGACTGAAAAGCCTTACTCGA  
TTTGCCCTCCTGTTGATATGGAAACGGGTGAAATTCTGACAGAGGAAGCTGTTCAAATCTTCCACCTAT  
TCCAGAAGAAAAGTGGGTGGAACCAGAAATCATCTGCCTCAAGCTGAACTTAAATTCCTGAACAGGA  
AGATGACTCAGATGACGAAGATGTTTCAGGTGATTTTTAGCCAAAAGAAGCCCTTGAATACAACTTCC  
AAGCTTACAACCTTTTGACCAGATAAACCAAAAGATCAGTCTAAAGAGAAGAAAATTGTCAGAGAAAA  
TATCAAATCTTAGAAGCAACCTTTGCTAGCTTTGGTATTAAGGTAACAGTTGAACGGGCCGAAATTGG  
GCCATCAGTGACCAAGTATGAAGTCAAGCCGGCTGTTGGTGAAGGGTCAACCGCATTTCCAATCTATC  
AGATGACCTCGCTCTAGCCTTGGCTGCCAAAGATGTCCGGATTGAAGCACCATCCCTGGGAAATCCCT  
AATCGGAATTGAAGTGCCCAACTCCGATATTGCCACTGTATCTTTCCGAGAACTATGGGAACAATCGCA  
AACGAAAGCAGAAAATTTCTTGGAATTCCTTTAGGGAAGGCTGTTAATGGAACCGCAAGAGCTTTTGA  
CCTTTCTAAAATGCCCCACTTGCTAGTTGCAGGTTCAACGGGTTTCAGGGAAGTCAGTAGCAGTTAACGG  
CATTATTGCTAGCATTCTCATGAAGGCGAGACCAGATCAAGTTAAATTTATGATGGTTCGATCCCAAGAT  
GGTTGAGTTATCTGTTTACAATGATATTCCCCACCTCTTGATTCCAGTCGTGACCAATCCACGCAAAGC  
CAGCAAGGCTCTGAAAAGGTTGTGGATGAAATGGAAAACCGTTATGAACTCTTTGCCAAGGTGGGAGT  
TCGGAATATTGCAGGTTTTAATGCCAAGGTAGAAGAGTTCAATTCACAGTCTGAGTACAAGCAAATTCC



Table 1

GCTACCATTTCATTGTCGTGATTGTGGATGAGTTGGCTGACCTCATGATGGTGGCCAGCAAGGAAGTGGAA  
AGATGCTATCATCCGCTCTTGGGCAGAAAGGCGCGTGCTGCAGGTATCCACATGATTCTTGCAACTCAGCG  
TCCATCTGTTGATGTCATCTCTGGTTTGATTAAGGCCAATGTTCCATCTCGTGTAGCATTTCGCGTTTC  
ATCAGGAACAGACTCCCGTACGATTTTGGATGAAAATGGAGCAGAAAACTTCTTGGTCGAGGAGACAT  
GCTCTTTAAACCGATTGATGAAAATCATCCAGTTCGTCTCCAAGGCTCCTTTATCTCGGATGACGATGT  
TGAGCGCATTGTGAACCTCATCAAGACTCAGGCAGATGCAGACTACGATGAGAGTTTTGATCCAGGTGA  
GGTTTCTGAAAATGAAGGAGAATTTTCGGATGGAGATGCTGGTGGTGATCCGCTTTTTGAAGAAGCTAA  
GTCTTTGGTTATCGAAACACAGAAAGCCAGTGCGTCTATGATTCAGCGTCGTTTTATCAGTTGGATTAA  
CCGTGCGACCCGCTCTCATGGAAGAAGCTGGAGATAGCAGGTGTCATCGGTCCAGCTGAAGGTACCAAACC  
TCGAAAAGTGTTACAACAA

**SP078 amino acid (SEQ ID NO:132)**

RGFAKWWEHERRKEERFVKQEEKARQKAEKEARLEQEETEKALLDLPPVDMETGEILTEEAVQNLPPPI  
PEEKWVEPEIILPQAEKLFPEQEDSDDEDVQVDFSAKEALEYKLPQLFAPDKPKDQSKEKKIVREN  
IKILEATFASFGIKVTVERAEIGPSVTKEYEVKPAVGVRVNRISNLSDDLALALAAKDVRIEAPIPGKSL  
IGIEVPNSDIATVSFRELWEQSQTAKENFLEIPLGKAVNGTARAFDLKMPHLLVAGSTGSGKSVAVNG  
IIASILMKARPQVKFMMVDPKMVELSVYNDIPHLLIPVVTNPRKASKALQKVVDENENRYELFAKVG  
RNIAGFNAKVEEFNSQSEYKQIPLPFIIVIVDELADLMMVASKEVEDAIIRLGQKARAAGIHMILATQR  
PSVDVISGLIKANVPSRVAFAVSSGTDSTILDENGAEKLLGRGDMFLFKPIDENHPVRLQGSFISDDDV  
ERIVNFIKTQADADYDESFDPEVSENEGEFSDDGAGDPLFEEAKSLVIETQKASASMIQRRLSVGFN  
RATRLMEELEIAGVIGPAEGTKPRKVLQQ

**SP079 nucleotide (SEQ ID NO:133)**

TCAAAAAGAGAAGGAAAACCTTGGTTATTGCTGGGAAAATAGGTCCAGAACCAGAAATTTTGGCCAATAT  
GTATAAGTTGCTGATTGAAGAAAATACCAGCATGACTGCGACTGTAAACCGAATTTTGGGAAGACAAG  
CTTCCTTTTATGAAGCTCTGAAAAAAGGCGATATTGACATCTATCCTGAATTTACTGGTACGGTGACTGA  
AAGTTTGCTTCAACCATCACCAAGGTGATCATGAACCAGAACAGGTTTATCAGGTGGCGCGTGATGG  
CATTGCTAAGCAGGATCATCTAGCCTATCTCAAACCCATGTCTTATCAAAACACCTATGCTGTAGCTGT  
TCCGAAAAAGATTGCTCAAGAATATGGCTTGAAGACCATTTCAGACTTGAAAAAAGTGGAAGGGCAGTT  
GAAGGCAGGTTTTTACACTCGAGTTTAAACGACCGTGAAGATGGAAATAAGGGCTTGCAATCAATGTATGG  
TCTCAATCTCAATGTAGCGACCATTGAGCCAGCCCTTCGCTATCAGGCTATTCAGTCAGGGGATATTCA  
AATCACGGATGCCTATTGACTGATGCGGAATTGGAGCGTTATGATTTACAGGTCTTGGAAGATGACAA  
GCAACTCTTCCACCTTATCAAGGGGCTCCACTCATGAAAGAAGCTCTTCTCAAGAAACACCCAGAGTT  
GGAAAGAGTTCTTAATACATTGGCTGGTAAGATTACAGAAAGCCAGATGAGCCAGCTCAACTACCAAGT  
CGGTGTTGAAGGCAAGTCAGCAAAGCAAGTAGCCAAGGAGTTTCTCCAAGAACAAGGTTTGTGTAAGAA  
A

**SP079 amino acid (SEQ ID NO:134)**

QKEKENLVIAGKIGPEPEILANMYKLLIEENTSMTATVKPNFGKTSFLYEALKKGDIDIDYPEFTGTVTE  
SLLQPSPKVSHEPEQVYQVARDGIAKQDHLAYLKPMYSQNTYAVAVPKKIAQEYGLKTIISDLKKVEGQL  
KAGFTLEFNDREDGNKGLQSMYGLNLNVATIEPALRYQAIQSGDIQITDAYSTDAELERYDLQVLEDDK  
QLFPPYQGAPLMKEALLKKHPELERVLNLTLAGKITESQMSQLNYQVGVGKSAKQVAKEFLQEQLLKK

**SP080 nucleotide (SEQ ID NO:135)**

ACGTTCTATTGAGGACCACTTTGATTCAAACCTTGAATTTGGAATATAACCTCAAAGAAAAAGGGAAAAC  
AGATCTTTTGAAGCTAGTTGATAAAACAAGTGCATGCGTCTGCATTTTATCCGCCAAACTCATCCAGC  
CGGTCTCGGAGATGCTGTTTTGCAAGCCAAGGCTTTCGTGCGAAATGAACCTTTTGTGCTTATGCTTGG  
TGATGACTTGATGGATATCACAGACGAAAAGGCTGTTCACCTTACCAAACAAGTATCTGCTTACGGGGTTAT  
GCGTACCCACGCGTCTACTATCGCTGTCATGCCAGTCCCTCATGACGAAGTATCTGCTTACGGGGTTAT  
TGCTCCGCAAGGCGAAGGAAAAGATGGTCTTTACAGTGTGAAACCTTTGTTGAAAAACCAGCTCCAGA  
GGACGCTCCTAGCGACCTTGCTATTATCGGACGCTACCTCCTCACGCCTGAAATTTTTGAGATTCTCGA  
AAAGCAAGCTCCAGGTGCAGGAAATGAAATTCAGCTGACAGATGCAATCGACACCCTCAATAAAACACA  
ACGTGTATTTGCTCGTGAGTTCAAAGGGGCTCGTTACGATGTCGGAGACAAGTTTGGCTTCATGAAAAC  
ATCCATCGACTACGCCCTCAAACACCCACAAGTCAAAGATGATTTGAAGAATTACCTCATCCAACCTTGG  
AAAAGAATTGACTGAGAAGGAA

Table 1

**SP080 amino acid (SEQ ID NO:136)**

RSIEDHFDNSFELEYNLKEKGKTDLLKLVDKTTDMRLHFIRQTHPRGLGDAVLQAKAFVGNPFVVMLG  
DDLMDITDEKAVPLTKQLMDDYERTHASTIAVMPVPHDEVSAYGVIAPQGEKDGLYSVETFVEKPAP  
DAPSDLAIIIGRYLLTPEIFEILEKQAPGAGNEIQLTDAIDTLNKTQRFVAREFKGARYDVGDKFGFMKT  
SIDYALKHPQVKDDLKNYLIQLGKELTEKE

**SP081 nucleotide (SEQ ID NO:137)**

CGCTCAAAATACCAGAGGTGTTTCAGCTAATCGAGCACGTTTCTCCTCAAATGTTGAAAGCCCAATTGGA  
GAGTGTCTTTTCTGATATTCCACCTCAGGCTGTAAAACTGGAATGTTGGCTACTACTGAAATCATGGA  
AATCATCCAACCCTATCTTAAAAAACTGGATTGTCCCTATGTCCTTGATCCTGTTATGGTTGCTACAAG  
TGGAGATGCCTTGATTGACTCAAATGCTAGAGACTATCTCAAAACAAACTTACTACCTCTAGCAACTAT  
TATTACGCCAAATCTTCCTGAAGCAGAAGAGATTGTTGGTTTTTCAATCCATGACCCCGAAGACATGCA  
GCGTGTGGTGCCTGATTTTAAAGAATTTGGTCTCAGTCTGTGGTTATCAAAGGCGGACATCTCAA  
AGGTGGTGCTAAAGATTTCTCTTTACCAAGAATGAACAATTTGTCTGGGAAAGCCACGAATTCAAAC  
CTGTACACCCCATGGTACT

**SP081 amino acid (SEQ ID NO:138)**

AQNTRGVQLIEHVSPQMLKAQLESVFS DIPQAVKTGMLATTEIMEIIQPYLKKLDPCYVLDPVMVATS  
GDALIDSNARDYLKTNLLPLATIIITPNLPEAEIEVGF SIHDPEDMQRAGRLILKEFGPQSVVIKGGHLK  
GGAKDFLFTKNEQFVWESPRIQTCHTHGT

**SP082 nucleotide (SEQ ID NO:139)**

AATTGTACAATTAGAAAAAGATAGCAAATCAGACAAAGAACAAGTTGATAAACTATTTGAATCATTGGA  
TGCATCTTCAGATGAATCTATTTCTAAATTTAAAGAACTATCTGAACTTCACTTAAAACCGATGCAGG  
TAAAGACTATCTTAATAACAAAGTCAAAGAATCATCTAAAGCAATTGTAGATTTTCATTTGCAAAAAGG  
TTTGGCTTATGATGTTAAAGATTCAGATGACAAATTTAAAGATAAAGCAACTCTTGAAACAAATGTAAA  
AGAAATTACAAAACAATTTGATTTTATCAAAAAGTTGATGAACTTTTAAACAAGAGAATTTGGAAGA  
AACTCTTAAATCTCTAAATGATCTTTGTTGATAAATATCAAAAACAAATCGAATTTTGAAGAAAGAAGA  
AGAAAAAGCTGCTGAAAAAGCTGCTGAAAAAGCAAAGGAATCTTCTAGTCAAAGTAATTTCTTCTGGTAG  
TGCTTCTAATGAGTCTTATAATGGATCTTCCAATTCAAATGTAGATTATAGTTTATCTGAACAACTAA  
TGGATATTCAAATAATTATGGCGGTCAAGATTATTTCTGGTTTCAAGGAGATAGTTCAACAAATGGTGGATC  
ATCAGAACAATATTCATCTAGCAATTCAAACAGCGGAGCAAATAATGTCTACAGATATAAAGGCACTGG  
TGCTGACGGCTATCAAAGATACTACTACAAAGATCATAATAATGGAGATGTGTATGATGACGATGGAAA  
TTACCTTGGGAACTTTGGTGGCGGCATTGCAGAACCTAGTCAACGC

**SP082 amino acid (SEQ ID NO:140)**

IVQLEKDSKSDKEQVDKLFESFDASSDESISKLEKSETSLKTDAGKDYLNNKVKESSKAIVDFHLQKG  
LAYDVKDSDDKFKDKATLETNVKEITKQIDFIKKVDETFFKQENLEETLKSNDLVVDKYQKQIELLKKEE  
EKAAEKAAEKAKESSQSNSSGSASNESYNGSSNSNVDYSSSEQTNGYSNNYGGQDYSGSGDSSTNGGS  
SEQYSSSNSNSGANNVYRYKGTGADGYQRYYYKDHNNGDVYDDGNYLGNFGGGIAEPSQR

**SP083 nucleotide (SEQ ID NO:141)**

TCTGACCAAGCAAAAAGAAGCAGTCAATGACAAAGGAAAAGCAGCTGTTGTTAAGGTGGTGGAAAGCCA  
GGCAGAATCTTATAGCTTAGAAAAGAATGAAGATGCTAGCCTAAGAAAGTTACAAGCAGATGGACGCAT  
CACGGAAGAACAGGCTAAAGCTTATAAAGAATACAATGATAAAAATGGAGGAGCAAATCGTAAAGTCAA  
TGAT

**SP083 amino acid (SEQ ID NO:142)**

LTKQKEAVNDKGKAAVVKVVESQAELYSLKNEASLRKLQADGRITEEQAKAYKEYNDKNGGANRKVN  
D

**SP084 nucleotide (SEQ ID NO:143)**

GTCCGGCTCTGTCCAGTCCACTTTTTCAGCGGTAGAGGAACAGATTTTCTTTATGGAGTTTGAAGAACT  
CTATCGGGAAACCCAAAAACGCAGTGTAGCCAGTCAGCAAAAGACTAGTCTGAACCTTAGATGGGCAGAC  
GCTTAGCAATGGCAGTCAAAAGTTGCCAGTCCCTAAAGGAATTCAGGCCCCATCAGGCCAAAGTATTAC  
ATTTGACCGAGCTGGGGGCAATTCGTCCCTGGCTAAGGTTGAATTTAGACCAGTAAAGGAGCGATTTCG  
CTATCAATTATATCTAGGAAATGGAAAAATTAAACGCATTAAGGAAACAAAAAT

Table 1

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**SP084 amino acid (SEQ ID NO:144)**

SGSVQSTFSAVEEQIFFMEFEELYRETQKRSVASQQKTSLNLDGQTLNNGSQKLPVPKGIQAPSGQSIT  
FDRAGGNSSLAKVEFQTSKGAIRYQLYLGNGKIKRIKETKN

**SP085 nucleotide (SEQ ID NO:145)**

GGGACAAATTCAAAAAAATAGGCAAGAGGAAGCAAAAATCTTGCAAAAGGAAGAAGTCTTGAGGGTAGC  
TAAGATGGCCCTGCAGACGGGGCAAAATCAGGTAAGCATCAACGGAGTTGAGATTCAGGTATTTTCTAG  
TGAAAAAGGATTGGAGGTCTACCATGGTTCAGAACAGTTGTTGGCAATCAAAGAGCCA

**SP085 amino acid (SEQ ID NO:146)**

GQIQKNRQEEAKILQKEEVLRAKMALQTGQNQVSINGVEIQVFSSEKGLVYHGSEQLLAIKEP

**SP086 nucleotide (SEQ ID NO:147)**

TCGCTACCAGCAACAAAGCGAGCAAAAGGAGTGGCTCTTGTGTTGTGGACCAACTTGAGGTAGAATTAGA  
CCGTTCGCAGTTCGAAAAAGTAGAAGGCAATCGCCTATACATGAAGCAAGATGGCAAGGACATCGCCAT  
CGGTAAGTCAAAGTCAGATGATTTCCGTAAAACGAATGCTCGTGGTCGAGGTATCAGCCTATGGTTTA  
TGGACTCAAATCTGTACGGATTACAGAGGACAATCAACTGGTTCGCTTTCATTTCCAGTTCCAAAAAGG  
CTTAGAAAGGGAGTTCATCTATCGTGTGGAAAAAGAAAAAGT

**SP086 amino acid (SEQ ID NO:148)**

RYQQQSEQKEWLLFVDQLEVELDRSQFEKVEGNRLYMKQDGKDIAIGKSKSDDFRKTNARGRGYQPMVY  
GLKSVRITEDNQLVRHFHFQFKGLEREFYRVEKEKS

**SP087 nucleotide (SEQ ID NO:149)**

GAACCGACAAGTCGCCCACTATCAAGACTATGCTTTGAATAAAGAAAAATTGGTTGCTTTTGCTATGGC  
TAAACGAACCAAAGATAAGGTTGAGCAAGAAAGTGGGGAACAGTTTTTTAATCTAGGTCAGGTAAGCTA  
TCAAAACAAGAAAACTGGCTTAGTGACGAGGTTTCGTACGGATAAGAGCCAATATGAGTTTCTGTTTCC  
TTCAGTCAAAATCAAAGAAGAGAAAAAGAGATAAAAAAGGAAGAGGTAGCGACCGATTCAAGCGAAAAAGT  
GGAGAAGAAAAAATCAGAAGAGAAGCCTGAAAAAGAAAGAGAATTCA

**SP087 amino acid (SEQ ID NO:150)**

NRQVAHYQDYALNKEKLVAFAMAKRTKDKVEQESGEQFFNLGQVSYQNKKTGLVTRVRTDKSQYEFLFP  
SVKIKEEKRDKKEEVATDSSEKVEKKKSEEKPEKKENS

**SP088 nucleotide (SEQ ID NO:151)**

GGTTGTGGCTGGCAATATATCCCGTTTCCATCTAAAGGTAGTACAATTGGTCCTTACCCAAATGGTAT  
CAGATTAGAAGTTTTTCCAAAGTCAGAGTGGTACTACTTCGATAAAAATGGAGTGCTACAAGAGTTTGT  
TGGTTGGAACATTAGAGATTAAAACTAAAGACAGTGTGGAAGAAAGTACGGGGAACGTTGAAGA  
TTCAGAAGATAAAGAAGAGAAGCGTTATTATACGAACATTACTTTAATCAAAATCATTCTTTAGAGAC  
AGGTTGGCTTTATGATCAGTCTAACTGGTATTATCTAGCTAAGACGGAAATTAATGGAGAAAACCTACCT  
TGGTGGTGAAAGACGTGCGGGGTGGATAAACGATGATTCGACTTGGTACTACCTAGATCCAACAACCTGG  
CACTGGCTGGTATCAGGAAGGTACCACTTGGTATTATTTAGACCACCCAAATGGCGATATGAAAACAGG  
TTGGCAAAACCTTGGGAACAAATGGTACTATCTCCGTTCATCAGGAGCTATGGCAACTGGTTGGTATCA  
AGATGGTTCAACTTGGTACTACCTAAATGCAGGTAATGGAGACATGAAGACAGGTTGGTTCCAGGTCAA  
TGGCAACTGGTACTATGCTTATAGCTCAGGTGCTTTGGCAGTGAATACGACCGTAGATGGCTATTCTGT  
CAACTATAATGGCGAATGGGTTCCG

**SP088 amino acid (SEQ ID NO:152)**

VVGWQYIPFPSKSGSTIGPYPNGIRLEGFPKSEWYYFDKNGVLQEFVGWKTLEIKTKDSVGRKYGEKRED  
SEDKEEKRYYTNYFQNHSLQWLYDQSNWYYLAKTEINGENYLGGERAGWINDDSTWYYLDPTTG  
IMQTGWQYLGKWWYYLRSSGAMATGWYQEGTTWYYLDHPNGDMKTGWQNLGNKWWYYLRSSGAMATGWYQ  
DGSTWYYLNAGNGDMKTGWQVNGNWWYYAYSSGALAVNTTVDGYSVNYNGEWR

**SP089 nucleotide (SEQ ID NO:153)**

GGCCAAATCAGAATGGGTAGAAGACAAGGGAGCCTTTTATTATCTTGACCAAGATGGAAAGATGAAAAG  
AAATGCTTGGGTAGGAACCTTCCTATGTTGGTGAACAGGTGCCAAAGTAATAGAAGACTGGGTCTATGA  
TTCTCAATACGATGCTTGGTTTATATCAAAGCAGATGGACAGCACGCAGAGAAAGAATGGCTCCAAAT

09765272.01220.1

Table 1

TAAAGGGAAGGACTATTATTTCAAATCCGGTGGTTATCTACTGACAAGTCAGTGGATTAATCAAGCTTA  
TGTGAATGCTAGTGGTGCCAAAGTACAGCAAGGTTGGCTTTTTGACAAACAATACCAATCTTGGTTTTTA  
CATCAAAGAAAATGGAACTATGCTGATAAAGAATGGATTTTCGAGAATGGTCACTATTATTATCTAAA  
ATCCGGTGGCTACATGGCAGCCAATGAATGGATTGGGATAAGGAATCTTGGTTTTATCTCAAATTTGA  
TGGGAAAATGGCTGAAAAGAATGGGTCTACGATTCTCATAGTCAAGCTTGGTACTACTTCAAATCCGG  
TGTTTACATGACAGCCAATGAATGGATTGGGATAAGGAATCTTGGTTTTATCTCAAATCTGATGGGAA  
AATAGCTGAAAAAGAATGGGTCTACGATTCTCATAGTCAAGCTTGGTACTACTTCAAATCCGGTGGTTA  
CATGACAGCCAATGAATGGATTGGGATAAGGAATCTTGGTTTTACCTCAAATCTGATGGGAAAATAGC  
TGAAAAAGAATGGGTCTACGATTCTCATAGTCAAGCTTGGTACTACTTCAAATCTGGTGGCTACATGGC  
GAAAAATGAGACAGTAGATGGTTATCAGCTTGGAAAGCGATGGTAAATGGCTTGGAGGAAAAACTACAAA  
TGAAAAATGCTGCTTACTATCAAGTAGTGCCTGTTACAGCCAATGTTTATGATTCAGATGGTGAAGGCT  
TTCTTATATATCGCAAGGTAGTGTCTGATGGCTAGATAAGGATAGAAAAAGTGATGACAAGCGCTTGGC  
TATTACTATTTCTGGTTTGTGAGGCTATATGAAAACAGAAGATTACAAGCGCTAGATGCTAGTAAGGA  
CTTTATCCCTTATTATGAGAGTGATGGCCACCGTTTTTATCACTATGTGGCTCAGAATGCTAGTATCCC  
AGTAGCTTCTCATCTTTCTGATATGGAAGTAGGCAAGAAATATTATTCGGCAGATGGCCTGCATTTTGA  
TGGTTTTAAGCTTGAGAATCCCTTCTTTTCAAAGATTAAACAGAGGCTACAACTACAGTGCTGAAGA  
ATTGGATAAGGTATTTAGTTTGCTAAACATTAACAATAGCCTTTTGGAGAACAAAGGGCGCTACTTTTAA  
GGAAGCCGAAGAACATTACCATATCAATGCTCTTTATCTCCTTGGCCATAGTGCCCTAGAAAGTAAGTG  
GGGAAGAAGTAAAATTGCCAAAGATAAGAATAATTTCTTTGGCATTACAGCCTATGATACGACCCCTTA  
CCTTCTGCTAAGACATTGATGATGTGGATAAGGGAATTTAGGTGCAACCAAGTGGATTAAGGAAAA  
TTATATCGATAGGGGAAGAACTTCTCTTGGAAACAAGGCTTCTGGTATGAATGTGGAATATGCTTCAGA  
CCCTTATTGGGGCGAAAAAATTGCTAGTGTGATGATGAAAATCAATGAGAAG

**SP089 amino acid (SEQ ID NO:154)**

AKSEWVEDKGAFYYLDQDGKMKRNAWVGTSYVGATGAKVIEDWVYDSQYDAWFYIKADGQHAKEWQLQI  
KGKDYFFKSGGYLLTSQWINQAYVNASGAKVQQGWLFDKQYQSWFYIKENGNYADKEWIFENGHYYYLK  
SGGYMAANEWIWDKESWFYLFKFDGKMAEKWVYDSHSQAWYYFKSGGYMTANEWIWDKESWFYLFKSDGK  
IAEKWVYDSHSQAWYYFKSGGYMTANEWIWDKESWFYLFKSDGKIAEKWVYDSHSQAWYYFKSGGYMA  
KNETVDGYQLGSDGKWLGGKTTNENAAYYQVVPVTANVYDSDEKLSYISQGSVWLDKDRKSDDKRLA  
ITISGLSGYMKTEDLQALDASKDFIPYYESDGHFRFYHYVAQNASIPVASHLSDMEVGKKYYSADGLHFD  
GFKLENPFLFKDLTEATNYSAEELDKVFSLLNINNSLLENKGATFKEAEEHYHINALYLLAHSALASNW  
GRSKIADKNNFFGITAYDTTPYLSAKTFDDVDKGILGATKWIKENYIDRGRTFLGNKASGMNVEYASD  
PYWGEKIASVMMKINEK

**SP090 nucleotide (SEQ ID NO:155)**

ATTTGCAGATGATTCTGAAGGATGGCAGTTTGTCCAAGAAAATGGTAGAACCTACTACAAAAGGGGGA  
TCTAAAAGAAACCTACTGGAGAGTGATAGATGGGAAGTACTATTATTTTGATCCTTTATCCGGAGAGAT  
GGTTGTCTGGCTGGCAATATATACCTGCTCCACACAAGGGGGTTACGATTGGTCCTTCTCCAAGAATAGA  
GATTGCTCTTAGACCAGATTGGTTTTATTTTGGTCAAGATGGTGTATTACAAGAATTTGTTGGCAAGCA  
AGTTTTAGAAGCAAAACTGCTACGAATACCAACAAACATCATGGGGAAGAATATGATAGCCAAGCAGA  
GAAACGAGTCTATTATTTTGAAGATCAGCGTAGTTATCATACTTTAAAAACTGGTTGGATTATGAAGA  
GGGTCAATTGGTATTATTTACAGAAGGATGGTGGCTTTGATTTCGCGCATCAACAGATTGACGGTTGGAGA  
GCTAGCACGTGGTTGGGTTAAGGATTACCTCTTACGTATGATGAAGAGAAGCTAAAAGCAGCTCCATG  
GTACTATCTAAATCCAGCAACTGGCATTATGCAACAGGTTGGCAATATCTAGGTAATAGATGGTACTA  
CCTCCATTCTGCTCAGGAGCTATGGCAACTGGCTGGTATAAGGAAGGCTCAACTTGGTACTATCTAGATGC  
TGAAAATGGTGATATGAGAACTGGCTGGCAAAACCTTGGGAACAAATGGTACTATCTCCGTTTCATCAGG  
AGCTATGGCAACTGGTTGGTATCAGGAAAGTTCGACTTGGTACTATCTAAATGCAAGTAATGGAGATAT  
GAAAACAGGCTGGTTCCAAGTCAATGGTAACTGGTACTATGCCTATGATTCAGGTGCTTTAGCTGTTAA  
TACCACAGTAGGTGGTTACTACTTAACTATAATGGTGAATGGGTAAAG

**SP090 amino acid (SEQ ID NO:156)**

VFADDSEGWQFVQENGRTYYKKGDLKETVYWRVIDGKYYYFDPLSGEMVVGWQYIPAPHKGVTTIGPSPRI  
EIALRPDWFYFGQDGVLEQFVVGKQVLEAKTATNTNKHGEEYDSQAEKRVYFYFEDQRSYHTLKTGWIYE  
EGHWYYLQKDGGFDSRINRLTVGELARGWVKDYPLTYDEEKLKAAPWYYLNPATGIMQTGWQYLGNRWY  
YLHSSGAMATGWYKEGSTWYYLDAENGDMRTGWQNLGNKWWYYLRSSGAMATGWYQESSTWYYLNASNGD  
MKTGWFFQVNGNWWYYAYDSGALAVNTTVGGYYLNYNGEWWK

097655272.012201

Table 1

**SP091 nucleotide (SEQ ID NO:157)**

TGTCGCTGCAAAATGAACTGAAGTAGCAAAAACCTTCGCAGGATACAACGACAGCTTCAAGTAGTTT CAGA  
GCAAAATCAGTCTTCTAATAAAACGCAAACGAGCGCAGAAGTACAGACTAATGCTGCTGCCCACTGGGA  
TGGGGATTATTATGTAAAGGATGATGGTTCTAAAGCTCAAAGTGAATGGATTTTGTACAAC TACTATAA  
GGCTTGGTTTTATATTAATTCAGATGGTCGTTACTTCGCAGAATGAATGGCATGGAAATTACTACCTGAA  
ATCAGGTGGATATATGGCCCCAAAACGAGTGGATCTATGACAGTAATTACAAGAGTTGGTTTTTATCTCAA  
GTCAGATGGGGCTTATGCTCATCAAGAATGGCAATTGATTGGAAATAAGTGGTACTTCAAGAAGTG  
GGGTTACATGGCTAAAAAGCCAATGGCAAGGAAGTTATTTCTTGAATGGTCAAGGAGCTATGATGCAAAA  
TGAATGGCTSCTATGATCCAGCCTATTCTGCTTATTTTTATCTAAAAATCCGATGGAACTTATGCTAACC  
AAGAGTGGCAAAAAGTGGGCGGCAAATGGTACTATTTCAAGAAGTGGGGCTATATGGCTCGGAATGAGT  
GGCAAGGCAACTACTATTTGACTGGAAGTGGTGCCATGGCGACTGACGAAGTGATTATGGATGGTACTC  
GCTATATCTTTGCGGCCCTCTGGTGAGCTCAAAGAAAAAAGATTTGAATGTCGGCTGGGTTACAGAG  
ATGGTAAGCGCTATTTCTTTAATAATAGAGAAGAACAAGTGGGAACCGAACATGCTAAGAAAGTCATTG  
ATATTAGTGAGCACAATGGTCGTATCAATGATTGGAAGGTTATTGATGAGAACGAAGTGGATGGTG  
TCATTGTTCTGCTAGGTTATAGCGGTAAAGAAGACAAGGAATTGGCGCATAACATTAAGGAGTTAAACC  
GTCTGGGAATTCCTTATGGTGTCTATCTCTATACCTATGCTGAAAATGAGACCGATGCTGAGAGTGACG  
CTAAACAGACCATTGAACTTATAAAGAAATACAATATGAACCTGTCTTACCCTATCTATTATGATGTTG  
AGAATTGGGAATATGTAAATAAGAGCAAGAGAGCTCCAAGTGATACAGGCCACTTGGGTTAAATCATCA  
ACAAGTACATGGACACGATGAAGCAGGCGGGTTATCAAAATGTGTATGTCTATAGCTATCGTAGTTTAT  
TACAGACCGGTTTAAACACCCAGATATTTTAAACATGTAAACTGGGTAGCGGCCCTATACGAATGCTT  
TAGAATGGGAAAACCCCTCATTTTACAGAAAAAAGGTTGGCAATATACCTCTTCTGAATACATGAAAG  
GAATCCAAGGGCGCGTAGATGTCAGCGTTTGGTAT

**SP091 amino acid (SEQ ID NO:158)**

VAANETEVAKTSQDTTITASSSSEQNQSSNKTQTSAEVQTNAAAHWGDYVVKDDGSKAQSEWIFDNYYK  
AWFYINSDGRYSQNEWHGNYLKSGGYMAQNEWIYDSNYKSWFYLKSDGAYAHQEWQLIGNKWYFYFKKW  
GYMAKSQWQGSYFLNGQGAMMQNEWLYDPAYSAYFYLKS DGTYANQEWQKVGKWKYFYFKKWGYMARNEW  
QGNYYLTGSGAMATDEVIMDGTRYIFAASGELKEKKDLNVGWVHRDGKRYFFNNREEQVGT EHAKKVID  
ISEHNGRINDWKKVIDENEVDGVIVRLGYSGKEDKELAHNIKELNRLGIPYGVYLYTYAENETDAESDA  
KQTIELIKKYNMNLSPYIYDVENWEYVNKSKRAPSDTGTWVKIINKYMDTMKQAGYQNVVYSYRSL  
QTRLKHPDILKHVNWVAAYTNALEWENPHYS GKKGWQYTSSEYMKGIQGRVDVSVWY

**SP092 nucleotide (SEQ ID NO:159)**

TACGTCTCAGCCTACTTTTGTAAAGAGCAGAAGAATCTCCACAAGTTGTGCAAAAATCTTCATTAGAGAA  
GAAATATGAGGAAGCAAAAGCAAAAGCTGATACTGCCAAGAAAGATTACGAAACGGCTAAAAAGAAAGC  
AGAAGACGCTCAGAAAAAGTATGAAGATGATCAGAAGAGAACTGAGGAGAAAGCTCGAAAAGAAGCAGA  
AGCATCTCAAAAATTGAATGATGTGGCGCTTGTTGTTCAAAAATGCATATAAAGAGTACCGAGAAGTTCA  
AAATCAACGTAGTAAATATAAATCTGACGCTGAATATCAGAAAAAATTAACAGAGGTGACTCTAAAAT  
AGAGAAGGCTAGGAAAGAGCAACAGGACTTGCAAAAATAAATTTAATGAAGTAAGAGCAGTTGTAGTTCC  
TGAACCAAATGCGTTGGCTGAGACTAAGAAAAAAGCAGAAGAAGCTAAAGCAGAAGAAAAAGTAGCTAA  
GAGAAAAATATGATTATGCAACTCTAAAGGTAGCATAAGCAAGAAAGTAGAGGCTAAGGAAGTTGA  
AATTGAAAAAATTCAATATGAAATTTCTACTTTGGAACAAAGAAGTTGCTACTGCTCAACATCAAGTAGA  
TAATTTGAAAAAATTCTTGCTGGTGCGGATCCTGATGATGGCACAGAAGTTATAGAAGCTAAATTA  
AAAAGGAGAAGCTGAGCTAAACGCTAAACAAGCTGAGTTAGCAAAAAACAAACAGAACTTGAAAACT  
TCTTGACAGCCTTGATCCTGAAGGTAAGACTCAGGATGAATTAGATAAAGAAGCAGAAGAAGCTGAGTT  
GGATAAAAAAGCTGATGAACCTCAAAATAAAGTTGCTGATTTAGAAAAAGAAATTAGTAACCTTGAAAT  
ATTACTTGGAGGGGCTGATNCTGAAGATGATACTGCTGCTCTTCAAAATAAATTAGCTACTAAAAAAGC  
TGAATTGGAAAAAAGCTCAAAAAGAATTAGATGCAGCTCTTAATGAGTTAGGCCCTGATGGAGATGAAGA  
AGAACTCCAGCGCCGGCTCCTCAACCAGAGCAACCAGCTCCTGCACCAAAACCAGAGCAACCAGCTCC  
AGCTCCAAAACCAGAGCAACCAGCTCCTGCACCAAAACCAGAGCAACCAGCTCCAGCTCCAAAACCAGA  
GCAACCAGCTCCAGCTCCAAAACCAGAGCAACCAGCTAAGCCGGAGAAACCAGCTGAAGAGCCTACTCA  
ACCAGAAAAACCAGCCACTCCAAAACAGGCTGGAAACAAGAAAACGGTATGTGGTATTTCTACAATAC  
TGATGGTTCAATGGCAATAGGTTGGCTCCAAAACAACGGTTTCATGGTACTACCTAAACGCTAACGGCGC  
TATGGCAACAGGTTGGGTGAAAGATGGAGATACCTGGTACTATCTTGAAGCATCAGGTGCTATGAAAGC  
AAGCCAATGGTTCAAAGTATCAGATAAATGGTACTATGTCAACAGCAATGGCGCTATGGCGACAGGCTG  
GCTCCAATACAATGGCTCATGGTACTACCTCAACGCTAATGGTGATATGGCGACAGGATGGCTCCAATA  
CAACGGTTCATGGTATTACCTCAACGCTAATGGTGATATGGCGACAGGATGGGCTAAAGTCAACGGTTC  
ATGGTACTACCTAAACGCTAACGGTGCTATGGCTACAGGTTGGGCTAAAGTCAACGGTTCATGGTACTA

Table 1

CCTAAACGCTAACGGTTCAATGGCAACAGGTTGGGTGAAAGATGGAGATACCTGGTACTATCTTGAAGC  
ATCAGGTGCTATGAAAGCAAGCCAATGGTTCAAAGTATCAGATAAATGGTACTATGTCAATGGCTTAGG  
TGCCCTTGCAAGTCAACACAACCTGTAGATGGCTATAAAGTCAATGCCAATGGTGAATGGGTT

**SP092 amino acid (SEQ ID NO:160)**

TSQPTFVRAEESPQVVEKSSLEKKYEEAKAKADTAKKDYETAKKKAEDAQKKYEDDQKRTEEKARKEAE  
ASQKLNDAVALVQNAVKEYREVQNORSKYKSDAEYQKKLTEVDSKIEKARKEQQDLQNKFNVRVAVVP  
EPNALAETKKKAEEAKAEKVAKRKYDYATLKVALAKKEVEAKELEIEKLQYEISTLEQEVATAQHQVD  
NLKKLLAGADPDDGTEVIEAKLKKGEAELNAKQAEALAKKQTELEKLLDSLDPGKTQDELKEAEEAEL  
DKKADELQNKVADLEKEISNLEILLGGADXEDDTAALQNKLATKKAELEKTQKELDAALNELGPDGDEE  
ETPAPAPQPEQPAPAPKPEQPAPAPKPEQPAPAPKPEQPAPAPKPEQPAPAPKPEQPAKPEKPAEEPTQ  
PEKPATPKTGWKQENGWYFYNTDGSMAIGWLQNGSWYYLNANGAMATGWVKDGDWYYLEASGAMKA  
SQWFKVSDKWYYVNSNGAMATGWLQYNGSWYYLNANGDMATGWLQYNGSWYYLNANGDMATGWAKVNGS  
WYYLNANGAMATGWAKVNGSWYYLNANGSMATGWVKDGDWYYLEASGAMKASQWFKVSDKWYYVNLG  
ALAVNTTVDGYKVNANGEWV

**P093 nucleotide (SEQ ID NO:161)**

TGGACAGGTGAAAGGTCATGCTACATTTGTGAAATCCATGACAACTGAAATGTACCAAGAACAACAGAA  
CCATTCTCTCGCCTACAATCAACGCTTGGNTTCGCAAAATCGCATTGTAGATCCTTTTTTGGCGGAGGG  
ATATGAGGTCAATTACCAAGTGTCTGACGACCTTGATGCAGTCTATGGTTACTTGTCTATTCCAAGTTT  
GGAAATCATGGAGCCGGTTTATTTGGGAGCAGATTATCATCATTTAGGGATGGGCTTGGCTCATGTGGA  
TGGTACACCGCTGCCTCTGGATGGTACAGGGATTTCGCTCAGTGATTGCTGGGCACCGTGCAGAGCCAAG  
CCATGTCTTTTTCCGCCATTTGGATCAGCTAAAAGTTGGAGATGCTCTTTATTATGATAATGGCCAGGA  
AATTGTAGAATATCAGATGATGGACACAGAGATTATTTTACCGTCGGAATGGGAAAATTAGAATCGGT  
TAGCTCTAAAAATATCATGACCTTGATAACCTGCGATCCGATTCCTACCTTTAATAAACGCTTATTAGT  
GAATTTTGAACGAGTCGCTGTTTATCAAAAATCAGATCCACAAACAGCTGCAGTTGCGAGGGTTGCTTT  
TACGAAAGAAGGACAATCTGTATCGCGTGTGCAACCTCTCAATGGTTG

**SP093 amino acid (SEQ ID NO:162)**

GQVKGHATFVKSMTEMYQEQQNHSLAYNQRLXSQNRIVDPFLAEGYEVNYQVSDDPDAVYGYLSIPSL  
EIMEPVYLGADYHHLGMGLAHVDGTPLPLDGTGIRSVIAGHRAEPSHVFFRHLQDKVGDALYYDNGQE  
IVEYQMMDEIILPSEWEKLESVSSKNIMTLITCDPIPTFNKRLLVNFERVAVYQKSDPQTAARVAF  
TKEGQSVSRVATSQWL

**SP094 nucleotide (SEQ ID NO:163)**

GATTGCTCCTTTGAAGGATTTGAGAGAAACCATGTTGGAAATTGCTTCTGGTGCTCAAAATCTTCGTGC  
CAAGGAAGTTGGTGCCTATGAACTGAGAGAAGTAACCTCGCCAAATTAATGCTATGTTGGATCAGATTGA  
TCAGTTGATGGTAGCTATTTCGTAGCCAGGAAGAAACGACCCGTCAGTACCAACTTCAAGCCCTTTTCGAG  
CCAGATTAATCCACATTTCTCTATAACACTTTGGACACCATCATCTGGATGGCTGAATTTTCATGATAG  
TCAGCGAGTGGTGCAGGTGACCAAGTCCTTGGCAACCTATTTCCGCTTGGCGCTCAATCAAGGCAAGGA  
CTTGATTTGTCTCTCTGACGAAATCAATCATGTCCGCCAGTATCTCTTTATCCAGAAACAACGCTATGG  
AGATAAGCTGGAATACGAAATTAATGAAAATGTTGCCTTTGATAATTTAGTCTTACCCAAGCTGGTCTCT  
ACAACCCCTTTGTAGAAAATGCTCTTTACCATGGCATTAGGAAAAGGAAGGTCAGGGCCATATTAAACT  
TTCTGTCCAGAAAACAGGATTCGGGATTGGTCATCCGTATTGAGGATGATGGCGTTGGCTTCCAAGATGC  
TGGTGATAGTAGTCAAAGTCAACTCAAACGTGGGGGAGTTGGTCTTCAAATGTGATCAACGGCTCAA  
ACTTCATTTTGGAGCCAATTACCATATGAAGATTGATTCTAGACCCCAAAAAGGGACGAAAGTTGAAAT  
ATATATAAATAGAATAGAACTAGC

**SP094 amino acid (SEQ ID NO:164)**

IAPLKDLRETMLEIASGAQNLRAKEVGAYELREVTRQFNAMLDQIDQLMVAIRSQEETTRQYQLQALSS  
QINPHFLYNTLDTIIWMAEFHDSQRVVQVTKSLATYFRLALNQKDLICLSDEINHVRQYLFIQKQRYG  
DKLEYEINENVAFDNLVLPKLVLPVENALYHGIKEKEGQGHIKLSVQKQDSGLVIRIEDDGVGFQDA  
GDSSQSQQLKRGVGLQNVQRLKLHFGANYHMKIDSRPQKGTKEIYINRIETS

**SP095 nucleotide (SEQ ID NO:165)**

TAGGTCATATGGGACTTTTTTCTACAACAAAATAGGCTCCATAATATCTATAAGGGATTTACCCACTA  
CAAATATTATAGAGCCGAAAATTCACATCTAATATATGCAGACTACTTTGAAATGAAATTAATAAATTT  
ATTAAAGGATGACACAAAAGTTTTTGAATAATCTACATTCAAATTTGTAGAAGGATATAAATATACCT

Table 1

GACAGAATCTAAAGAATCTGGAATTAAACAAATGGACAATGTCATAAAATATTTTGAGTTTATTGAATC  
TAAAGTATTGCTTTATATTTTCAAAAACGATTAAATGAGCTGATAGAT

**SP095 amino acid (SEQ ID NO:166)**

RSYGTFFLQQNRLHNIYKGFTHYKYYRAENSHLIYADYFEMKLKLLKDDTKVFEKSTFKFVEGYKIYL  
TESKESGIKQMDNVIKYFEFIESKSIALYFQKRLNELID

**SP096 nucleotide (SEQ ID NO:167)**

CAACGTTGAGAATTATTTGCGAATGTGTTTGGATAGCATTTCAGAATCAGACGTATCAAAATTTTGAGTG  
TTTATTAATCAATGATGGCTCTCCAGATCATTCACAAAATATGTGAAGAATTTGTAGAGAAAGATTC  
TCGTTTCAAATATTTTGAGAAAGCAAACGGCGGCTTTTCATCAGCTCGTAACCTAGGTATTGAATGTTT  
GGGGGGGGCGTACATTACTTTTGTAGACTC

**SP096 amino acid (SEQ ID NO:168)**

NVENYLRMCLDSIQNTYQNFECLLINDGSPDHSSKICEEFVEKDSRFKYFEKANGGLSSARNLGI ECS  
GGGVHYFCRL

**SP097 nucleotide (SEQ ID NO:169)**

CTACTATCAATCAAGTTCTTCAGCCATTGAGGCCACCATTGAGGGCAACAGCCAAACGACCATCAGCCA  
GACTAGCCACTTTATTCAGTCTTATATCAAAAACTAGAAACCACCTCGACTGGTTTGACCCAGCAGAC  
GGATGTTCTGGCCTATGCTGAGAATCCAGTCAAGACAAGGTCGAGGGAATCCGAGATTTGTTTTTGAC  
CATCTTGAAGTCAGATAAGGACTTGAAAACCTGTTGTGCTGGTGACCAAATCTGGTCAGGTCATTTCTAC  
AGATGACAGTGTGCAGATGAAAACCTCCTCTGATATGATGGCTGAGGATTGGTACCAAAGGCCATTCA  
TCAGGGAGCTATGCCTGTTTTGACTCCAGCTCGTAAATCAGATAGTCAGTGGGTCAATTTCTGTCACTCA  
AGAACTTGTTGATGCAAAGGGAGCCAATCTTGGTGTGCTTCGTTTGGATATTTCTTATGAAACTCTGGA  
AGCCTATCTCAATCAACTCCAGTTGGGGCAGCAGGGCTTTGCCTTCATTATCAATGAAAACCATGAATT  
TGTCTACCATCCTCAACACACAGTTTATAGTTTCGTCTAGCAAATGGAGGCTATGAAACCCTACATCGA  
TACAGGTCAGGGTTATACTCCTGGTCACAAATCCTACGTCAGTCAAGAGAAGATTGCAGGAAGTATTG  
GACGGTGTCTGGCGTGTTCATCATTGGAAGTTAGACCAGGTTCCGGAGTCAG

**SP097 amino acid (SEQ ID NO:170)**

YYQSSSSAIEATIEGNSQTTISQTSHF IQSYIKKLETTSTGLTQQTDVLAYAENPSQDKVEGIRD LFLT  
ILKSDKDLKTVVLVTKSGQVISTDDSVQMKTSDDMAEDWYQKAIHQGAMPVLT PARKSDS QWVI SVTQ  
ELVDAKGANLGVLRDLISYETLEAYLNQLQLGQQGFAFIINENHEFVYHPQHTVYSSSSKMEAMKPYID  
TGQGYTPGHKSYVSQEKIAGTDWTVLVGS SLEKLDQVRSQ

**SP098 nucleotide (SEQ ID NO:171)**

GACAAAAACATTAAAACGTCCTGAGGTTTTATCACCTGCAGGGACTTTAGAGAAGCTAAAGGTAGCTGT  
TCAGTATGGAGCAGATGCTGTCTTTATCGGTGGTCAGGCCTATGGTCTTCGTAGCCGTGCGGGAAACTT  
TACTTTTCAACAGATGGAAGAAGGCGTGCAGTTTGCGGCCAAGTATGGTGCCAAGGTCTATGTAGCGGC  
TAATATGGTTATGCACGAAGGAAATGAAGCTGGTGTGGTGAGTGGTTCCGTAAACTGCGTGATATCGG  
GATTGCAGCAGTTATCGTATCTGACCCAGCCTTGATTATGATTGCAGTGACTGAAGCACCAGGCCTTGA  
AATCCACCTTTCTACCCAAGCCAGTGCCACTAACTATGAAACCCTTGAGTTCTGGAAAGAGCTAGGCTT  
GACTCGTGTCTGTTTTAGCGCGTGAGGTTTCAATGGAAGAATTAGCTGAGATCCGCAAACGTACAGATGT  
TGAAATTGAAGCCTTTGTCCATGGAGCTATGTGTATTTCTACTCTGGACGTTGTACTCTTTCAAACCA  
CATGAGTATGCGTGATGCCAACCGTGGTGGATGTTCTCAGTCATGCCGTTGGAATACGACCTTTACGA  
TATGCCATTTGGGAAAGAACGTAAGAGTTTGACGGGTGAGATTCAGAAGAATTTTCAATGTCAGCCGT  
TGACATGTCTATGATTGACCANATTCAGATATGATTGAAAATGGTGTGGACAGTCTAAAATCGAAGG  
ACGTATGNAGTCTATTCACTANGTATCAACAGTAACCAACTGCTACAAGGCGGCTGTGGATGCCTATCT  
TGAAAGTCCTGAAAAGTTTGAAGCTATCAACAAGACTTGGTGGACGAGATGTGGAAGGTTGCCCAACG  
TGAAGTGGCTACAGGATTTTACTATGGTACACCACTTGAAAATGAGCAGTTGTTTGGTGCTCGTCGTAA  
AATCCCTGAGTACAAGTTTGTCTGCTGAAGTGGTTTCTTATGATGATGCGGCACAAACAGCAACTATTCTG  
TCAACGAAACGTCATTAACGAAGGGGACCAAGTTGAGTTTTATGGTCCAGGTTTCCGTCATTTTGAAC  
CTATATTGAAGATTTGCATGATGCTAAAGGCAATAAAATCGACCGCGCTCCAAATCCAATGGAAGTATT  
GACTATTAAAGTCCACAACTGTTCAATCAGGAGACATGGTTCGAGCTCTTAAAGAGGGGCTTATCAA  
TCTTTATAAGGAAGATGGAACCAGCGTCACAGTTTCGTGCT

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Table 1

## SP098 amino acid (SEQ ID NO:172)

TKTLKRPEVLS PAGTLEKLKVAVQYGADAVFIGGQAYGLRSRAGNFTFEQMEEGVQFAAKYGAKVYVAA  
NMVMHEGNEAGAGEWFRKL RDIGIAAVIVSDPALIMIAVTEAPGLEIHLSTQASATNYETLEFWKELGL  
TRVVLAREVSMEELAEIRKRTDVEIEAFVHGAMCISYSGRCTL SNHMSMRDANRGGCSQSCRWKYDLYD  
MPFGKERKSLQGEIPEEF SMSAVDMSMIDXI PDMIENGVDLSLKIEGRMXSIHXVSTVTNCKYAAVDAYL  
ESPEKF EAIKQDLVDEMWKVAQRELATGFYYGTPSENEQLFGARRKIPEYKFVAEVVS YDDAAQTATIR  
QRNVINEGDQVEFYGPGRHF FETYIEDLHDAKGNKIDRAPNPMELLTIKVPQPVQSGDMVRALKEGLIN  
LYKEDGTSVTVRA

## SP099 nucleotide (SEQ ID NO:173)

TTCTCAGGAGACCTTTAAAAATATCACCAATAGCTTCTCCATGCAAATCAATCGTCGCGTCAACCAAGG  
AACGCCTCGTGGTGC TGGGAATATCAAGGGTGAAGACATCAAAAAATCACC GAAAACAAGGCCATTGA  
GTCTTATGTCAAACGTATCAACGCTATCGGAGATTTGACTGGATATGACCTGATTGAAACGCCAGAAAC  
CAAGAAGAATCTCACTGCTGATCGTGCCAAGCGTTTTTGGAAAGTAGCTTGATGATTACAGGTGTCAATGA  
CTCCTCTAAAGAAGACAAGTTTGTCTCTGGTTCTTATAAACTAGTCGAAGGAGAGCACTTAACCAACGA  
CGACAAGGATAAAATCTCTTGCACAAGGACTTGGCAGCCAAACACGGCTGGAAAGTAGGGGACAAGGT  
TAACTGGACTCTAATATCTACGATGCAGATAATGAAAAAGGAGCCAAGGAAACAGTTGAAGTGACAAT  
CAAGGGACTCTTTGATGGTCATAATAAGTCAGCAGTAACCTACTCACAAGAACTTTACGAAAACACAGC  
TATTACAGACATTACACTGCTGCAAACTTTATGGATACACAGAAGACACAGCCATTTATGGGGACGC  
AACCTTCTTTGTAACAGCAGACAAGAAGCTGGATGATGTTATGAAAGAGTTGAATGGCATCAGTGGTAT  
CAACTGGAAGAGCTACACACTCGTCAAGAGCTCCTCTAACTACCCAGCTCTTGAGCAATCTATCTCTGG  
TATGTACAAGATGGCCAAC

## SP099 amino acid (SEQ ID NO:174)

SQETFKNITNSFSMQINRRVNQGT PRGAGNIKGEDIKKITENKAIESYVKRINAIGDLTGYDLIETPET  
KKNLTADRAKRF GSSLMITGVNDSSKEDKFVSGSYKLVEGEHLTND DKDKILLHKDLAAKHGWKVGDKV  
KLD SNIYDADNEKGAKETVEVTIKGLFDGHNKSAVTYSQELYENTAITDIHTAAKLYGYTEDTAIYGDA  
TFFVTADKNLDDVMKELNGISGINWKS YTLVKSSSNYPAL EQSISGMYKMAN

## SP100 nucleotide (SEQ ID NO:175)

AGTAAATGCGCAATCAAATTCATTAATATTAATAGATGAACCTGAAATCTCACTTCATCCGAGTGCAAT  
CTATAAATTTAAAGAGTTTTTACTTCAAGAGTGT TTTAAATAAAAAACATCAAATTATTATCACTACACA  
TTCTACACAAC TTATAAAAGATTTTCTAGAGAAGCCGTGAAACTTTTAGTGAAAAACGGAGAAAAGGT  
AGATGTTATTGAAAATATTGATTATCAGGATGCATTTTTTGAATTAGGTGATGTGTATCATTCTAGGAA  
GATGATTTATGTTGAAGATAGACTAGCTAAATATATTCTAGAGTTTGTATCACTCATT CAGGTAGTGA  
GAATCTTAAACAGAATTTAGTAGTGAGATATATTCCTGGTGAGCAAATCAAATAATTTGTAATAATAT  
TTTAAACTCATCGTATTTAGATTCCGATAACCATTATTTTGGCTTGATGGAGATCAAAACACTAATGT  
TAGTGAATCAAATAATTTAATGAATATCTTGAAAATGGTGTGTTATATCAGATAAAATTCCTGAATC  
AGATAATAAAAAATCTTGATGATATTATAAAATTGATAANGGATGTCCAATTAATTTAATGTTTCAGG  
TAATAAAGGGCAAAAAATAATATTGAATTAATTGCGAAACAAAGAAGCTTTATAGATTATTGGGCTAA  
ATAC

## SP100 amino acid (SEQ ID NO:176)

VNAQNSNLILIDEPEISLHPSAIYKFKEFLLOECLNKKHQIIITTHSTQLIKDFPREAVKLLVKNGEKV  
DVIENIDYQDAFFELGDVYHSRKMIYVEDRLAKYILEFVITHSGSENKQNLVVRYPGGANQIIICNNI  
LNSSYLDSDNHYFWDGDQNTNVSESNLMNYLENGVVISDKIPESDNKNLDDIIKLIXGCPKIFNVSG  
NKGQKNNIELIAKQRSFIDYWAKY

## SP101 nucleotide (SEQ ID NO:177)

TTACCGCGTTTCATCAAGATGTCAAACAAGTCATGACCTATCAACCCATGGTGCGAGAAATATTGAGTGA  
ACAAGACACCCAGCAAACGAAGAGCTTGTGCTTGCTATGATTTATACTGAAACAAAAGGAAAAGAAGG  
CGATGTTATGCAGTCTAGTGAGTCTGCAAGTGGTTCACCAACACCATCAATGATAATGCCTCTAGCAT  
TCGGCAAGGCATTCAAACCTCTGACAGGCAATCTCTATCTGGCGCAGAAGAAGGGGGTAGATATCTGGAC  
AGCTGTTCAAGCCTATAATTTTGGACCTGCCTATATCGATTTTATCGCCCAAAATGGCAAGGAAAATAC  
CCTGGCTCTAGCCAAACAGTACTCTCGTGAGACTGTTGCCCCCTTGCTTGGTAATAGGACTGGAAAGAC  
TTATAGTTATATTCACCCCATTTCCATTTTTCACGGTGCTGAACTCTATGTAAATGGAGGAAACTATTA  
TTATTCTAGACAGGTACGACTTAACCTTTACATCATCAAATGTTTCACTCTCTTTTCAACATCTGGC



Table 1

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**SP101 amino acid (SEQ ID NO:178)**

YRVHQDVKQVMTYQPMVREILSEQDTPANEELVLAMIYTETKGKEGDMQSSSESASGSTNTINDNASSI  
RQGIQTLTGNLYLAQKKGVDIWTAVQAYNFGPAYIDFIAQNGKENTLALAKQYSRETVAPLLGNRTGKT  
YSYIHPISIFHGAELYVNGGNYYYSRQVRLNLYIIKCFTLFSTSG

**SP102 nucleotide (SEQ ID NO:179)**

GTGGATGGGCTTTAACTATCTTCGTATTTCGCCGTGCGGCTAAAAATTGTGGACAATGAGGAGTTTGAAGC  
CTTGATTTCGTACGGGTCAATTGATTGATTTGCGCGACCCAGCAGAATTCCACAGAAAACATATCCTTGG  
TGCACGCAATATTCCTTCAAGTCAGTTGAAAACCTAGTCTTGACGCCCTTCGTAAAGATAAACCTGTCCT  
TCTCTACGAAAACCAACGTGCGCAACGAGTTACAAATGCAGCTCTTACTTGAAAAACAAGGTTTTTC  
TGAGATTTATATCCTTTCTTATGGCTTGGATTCTTGAAAGGGAAAGTGAAGACTAGC

**SP102 amino acid (SEQ ID NO:180)**

WMGFNYLRIRRAAKIVDNEEFELIRTQGLIDLDPAEFHRKHILGARNIPSSQLKTSLAALRKDKPVL  
LYENQRAQRVTNAALYLKKQGFSEIYILSYGLDSWKGVKTS

**SP103 nucleotide (SEQ ID NO:181)**

ACTAAACCAGCATCGTTCGCAGGAAAATAAGGACAATAATCGTGTCTCTTATGTGGATGGCAGCCAGTC  
AAGTCAGAAAAGTGAAGCTTACACAGCAGCAGGTTAGCCAGAAAAGGAATTGAGGCTGAGCAAAT  
TGTAATCAAAATTACAGATCAGGGCTATGTAACGTCACACGGTGACCACTATCATTACTATAATGGGAA  
AGTTCCTTATGATGCCCTCTTTAGTGAAGAACTCTTGATGAAGGATCCAACTATCAACTTAAAGACGC  
TGATATTGTCAATGAAGTCAAGGGTGGTTATATCATCAAGGTCGATGGAAAATATTATGTCCTACCTGAA  
AGATGCAGCTCATGCTGATAATGTTTCGAACTAAAGATGAAATCAATCGTCAAAAACAAGAACATGTCAA  
AGATAATGAGAAGGTTAACTCTAATGTTGCTGTAGCAAGGCTTCAGGGACGATATACGACAAATGATGG  
TTATGTCTTTAATCCAGCTGATATTATCGAAGATACGGGTAATGCTTATATCGTTCCTCATGGAGGTCA  
CTATCACTACATTCCTCAAAAGCGATTTATCTGCTAGTGAATTAGCAGCAGCTAAAGCACATCTGGCTGG  
AAAAATATGCAACCGAGTCAGTTAAGCTATTCTTCAACAGCTAGTGACAATAACACGCAATCTGTAGC  
AAAAGGATCAACTAGCAAGCCAGCAAATAAATCTGAAAATCTCCAGAGTCTTTTGAAGGAACTCTATGA  
TTCACCTAGCGCCCAACGTTACAGTGAATCAGATGGCCTGGTCTTTGACCCTGCTAAGATTATCAGTCG  
TACACCAATGGAGTTGCGATTCCGCATGGCGACCAATTACCACTTTATTCCTTACAGCAAGCTTTCTGC  
CTTAGAAGAAAAGATTGCCAGAATGGTGCCTATCAGTGGAACCTGGTCTTACAGTTTCTACAAATGCAAA  
ACCTAATGAAGTAGTGTCTAGTCTAGGCAGTCTTTCAAGCAATCCTTCTTCTTTAACGACAAGTAAGGA  
GCTCTCTTCAGCATCTGATGGTTATATTTTAAATCCAAAAGATATCGTTGAAGAAACGGCTACAGCTTA  
TATTGTAAGACATGGTGATCATTTCCATTACATTCCAAAATCAAATCAAATGGGGCAACCGACTCTTCC  
AAACAATAGTCTAGCAACACCTTCTCCATCTCTTCCAATCAATCCAGGAACCTCACATGAGAAACATGA  
AGAAGATGGATACGGATTTGATGCTAATCGTATTATCGCTGAAGATGAATCAGGTTTTGTCATGAGTCA  
CGGAGACCACAATCATTATTTCTTCAAGAAG

**SP103 amino acid (SEQ ID NO:182)**

LNQHRSQENKDNRRVSYVDGSQSSQKSENLTDPQVSQKEGIAEQIVIKITDQGYVTSBGDHYHYNGK  
VPYDALFSEELMKDPNYQLKDADIVNEVKGGYIIKVDGKYVYLKDAHADNVRTKDEINRQKQEHVK  
DNEKVNNSNVAVARSQGRYTTNDGYVFNPAIIEDTGNAYIVPHGGHYHYIPKSDLSASELAAKAHLA  
KNMQPSQLSYSSTASDNNTQSVAKGSTSKPANKSENLSLLKELYDSPSAQRYSESDGLVFDPAKIIISR  
TPNGVAIPHGDHYHFIPYSKLSALEEKIARMVPISGTGSTVSTNAKPNEVVSSLGSLSSNPSSLTTSKE  
LSSASDGYIFNPKDIVEETATAYIVRHGDHFHYIPKSNQIGQPTLPNNSLATPSPSLPINPGTSHEKHE  
EDGYGFDANRIIAEDESFGVMShGDHNYFFKK

**SP105 nucleotide (SEQ ID NO:183)**

TGACTACCTTGAAATCCCACTTTACAGCTATCTTGGTGGATTCAACACTAAAGTTCTTCCAACCTCCAAT  
GATGAACATCATCAACGGTGGTTCTCACTCTGACGCTCCAATCGCTTTCCAAGAGTTCATGATCTTGCC  
AGTTGGTGGCCCAACATTTAAAGAAGCCCTTCGTTACGGTGCTGAAATCTTCCACGCTCTTAAGAAAAT  
CCTTAAATCACGTGGTTTGGAACTGCCGTAGGTGACGAAGGTGGATTGCTCCTCGTTTCGAAGGAAC  
TGAAGATGGTGTGAACTATCCTTGCTGCGATTGAAGCTGCTGGATATGTACCAGGTAAAGACGTATT  
TATCGGATTTGACTGTGCTTCATCAGAATTCTACGATAAAGAACGTAAAGTTTACGACTACACTAAAT  
TGAAGGTGAAGGTGCTGCTGTTTCGTACATCTGCAGAACAAATCGACTACCTTGAAGAATTGGTTAACAA  
ATACCCAATCATCACTATTGAAGATGGTATGGATGAAAACGACTGGGATGGTTGGAAAGCTCTTACTGA  
ACGTCTTGGTAAGAAAGTACAACCTTGTGGTGACGACTTCTTCGTAACAAACACTGACTACCTTGACG

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Table 1

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TGGTATCCAAGAAGGTGCTGCTAACTCAATCCTTATCAAAAGTTAACCAAATCGGTACTCTTACTGAAAC  
TTTTGAAGCTATCGAAATGGCTAAAGAAGCTGGTTACACTGCTGTTGTATCACACCGTTCAGGTGAAAC  
TGAAGATTCAACAATCGCTGATATTGCAGTTGCAACTAACGCAGGACAAATCAAGACTGGTTCACTTTC  
ACGTACAGACCGCATCGCTAAATACAACCAATTGCTTCGTATCGAAGACCAACTTGGTGAAGTAGCTGA  
ATATCGTGGATTGAAATCATTCTACAACCTTAAAAAA

**SP105 amino acid (SEQ ID NO:184)**

DYLEIPLYSYLGGFNTKVLPTPMNIIINGGSHSDAPIAFQEFMILPVGAPTFKEALRYGAEIFHALKKI  
LKSRGLETAVGDEGGFAPRFEGTEDGVETILAAIEAAGYVPGKDVFIGFDCASSEFYDKERKVDYDTKF  
EGEGAAVRTSAEQIDYLEELVNKYPIITIEDGMDENDWDGWKALTERLGKKVQLVGDDFFVTNTDYLAR  
GIQEGAANSILIKVNQIGTLTETFEAIEMAKEAGYTAVVSHRSGETEDSTIADIAVATNAGQIKTGSLS  
RTDRIAKYNQLLRIEDQLGEVAEYRGLKSFYNLKK

**SP106 nucleotide (SEQ ID NO:185)**

TCGTATCTTTTTTTGGAGCAATGTTGCGGTAGAAGGACATTCCATGGATCCGACCCTAGCGGATGGCGA  
AATTCTCTTCGTTGTAAACACCTTCTTATTGACCGTTTTGATATCGTGGTGGCCCATGAGGAAGATGG  
CAATAAGGACATCGTCAAGCGCGTGATTGGAATGCCTGGCGACACCATTCTGTACGAAAATGATAAACT  
CTACATCAATGACAAAGAAACGGACGAGCCTTATCTAGCAGACTATATCAAACGCTTCAAGGATGACAA  
ACTCCAAAGCACTTACTCAGGCAAGGGCTTTGAAGGAAATAAAGGAACCTTCTTTTAGAAGTATCGCTCA  
AAAAGTCAAGCCTTCACAGTTGATGTCAACTACAACACCAACTTTAGCTTTACTGTTCCAGAAGGAGA  
ATACCTTCTCCTCGGAGATGACCGCTTGGTTTTGAGCGACAGCCGCCACGTAGGTACCTTCAAAGCAA  
AGATATCACAGGGGAAGCTAAATTCCGCTTATGGCCAATCACCCGTATCGGAACATTT

**SP106 amino acid (SEQ ID NO:186)**

RIFWFSNVRVEGHSMDPTLADGEILFVVKHLPIDRFDIVVAHEEDGNKDIVKRVIGMPGDTIRYENDKL  
YINDKETDEPYLADYIKRFKDDKLQSTYSKGKFEKNKGTFFRSIAQKAQFTVDVNYNTNFSFTVPEGE  
YLLLGDDRVLVSSDSRHVGTFFKAKDITGEAKFRLWPITRIGTF

**SP107 nucleotide (SEQ ID NO:187)**

GGACTCTCTCAAAGATGTGAAAGCAAATGCTAGCGACAGCAAGCCTGCACAGGACAAGAAGGATGCAAA  
ACAAGGAACGGAAGATAGTAAGGATTAGATAAGATGACTGAAACAAACTCAGTTCCGGCAGGAGTGAT  
TGTGGTCAGTCTACTTGGCCCTCTAGGCGTGATTGCCTTCTGGCTGATTGCGCCGTAAGAAAGAGTCAGA  
AATCCAGCAATTAAGCACGGAATTGATCAAGGTTCTAGGACAGCTAGATGCAGAAAAAGCGGATAAAAA  
AGTCCTTGCCAAAGCCCAAAACCTTCTCCAAGAAACCCTTGATTTCTGTGAAAGAAGAAAATGGCTCAGC  
AGAGACAGAAACTAAACTAGTAGAGGAGCTTAAAGCAATCCTTGACAAACTCAAG

**SP107 amino acid (SEQ ID NO:188)**

DSLKDVKANASDSKPAQDKKDAKQGTEDSKSDSKMTETNSVPAGVIVVSLALLGVIAFWLIRRKKESE  
IQQLSTELIKVLGQLDAEKADKKVLAKAQNLLQETLDFVKEENGSAETETKLVEELKAILDKLK

**SP108 nucleotide (SEQ ID NO:189)**

CAAGAAATCCTATCATCTCTTCCAGAAGCAAACAGAGACGAGGGGAATTCAGACTCAGTTGATTGAAGA  
ATCGCTTAGTCAGCAGACTATAATCCAGTCCCTTCAATGCTCAAACAGAATTTATCCAAAGATTGCGTGA  
GGCTCATGACAACTACTCAGGCTATTCTCAGTCAGCCATCTTTTATTCTTCAACGGTCAATCCTTCGAC  
TCGCTTTGTAAATGCACTCATTATGCCCCTTTAGCTGGAGTAGGAGCTTATCGTATCATGATGGGTTT  
AGCCTTGACCGTCGGTCGTTTTAGTGACTTTTTTTGAACTATGTTTCAGCAATACACCAAGCCCTTTAACGA  
TATTTCTTCAGTGCTAGCTGAGTTGCAAAGTGCTCTGGCTTGCGTAGAGCGTATCTATGGAGTCTTAGA  
TAGCCCTGAAGTGGCTGAAACAGGTAAGGAAGTCTTGACGACCAGTGACCAAGTTAAGGGAGCTATTTT  
CTTTAAACATGTCTCTTTTGGCTACCATCCTGAAAAAATTTTGATTAAAGGACTTGTCTATCGATATTCC  
AGCTGGTAGTAAGGTAGCCATCGTTGGTCCGACAGGTGCTGGAAAATCAACTCTTATCAATCTCCTTAT  
GCGTTTTTATCCCATTAGCTCGGGAGATATCTTGCTGGATGGGCAATCCATTTATGATTATACACGAGT  
ATCATTGAGACAGCAGTTTGGTATGGTGCTTCAAGAAACCTGGCTCACACAAGGGACCATTTCATGATAA  
TATTGCCTTTGGCAATCCTGAAGCCAGTCGAGAGCAAGTAATTGCTGCTGCCAAAGCAGCTAATGCAGA  
CTTTTTTCATCCAACAGTTGCCACAGGGATACGATACCAAGTTGGAAAATGCTGGAGAATCTCTCTCTGT  
CGGCCAAGCTCAGCTCTTGACCATAGCCCAGTCTTTCTGGCTATTCCAAAGATTCTTATCTTAGACGA  
GGCAACTTCTTCCATTGATACACGGACAGAAGTGCTGGTACAGGATGCCTTTGCAAAACTCATGAAGGG  
CCGCACAAGTTTCATCATTTGCTCACCCTTTGTCAACCATTTCAGGATGCGGATTTAATTCTTGTCTTAGT

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Table 1

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AGATGGTGATATTGTTGAATATGGTAACCATCAAGAACTCATGGATAGAAAGGGTAAGTATTACCAAAT  
GCAAAAAGCTGCGGCTTTTAGTTCTGA

A

**SP108 amino acid (SEQ ID NO:190)**

KKSYHLFQKQTETRGITQLIEESLSQQTIIQSFNAQTEFIQRLREAHDNYSQSAIFYSSSTVNPST  
RFVNALIYALLAGVGAYRIMMGSALTVGRLVTFNLNVQQYTKPFNDISSVLAEQLSALACVERIYGVLD  
SPEVAETGKEVLTTSDQVKGAISFKHVSFGYHPEKILIKDLSIDIPAGSKVAIVGPTGAGKSTLINLLM  
RFYPISSGDILLDQSIYDYTRVSLRQQFGMVLQETWLTQGTIHDNIAFGNPEASREQVIAAKAANAD  
FFIQQLPQGYDTKLENAGESLSVGQAQLLTARVFLAIPKILILDEATSSIDTRTEVLVQDAFAKLMKG  
RTSFIIAHLSTIQDADLILVLVDGDIVVEYGNHQLMDRKGKYYQMKAASFSE

**SP109 nucleotide (SEQ ID NO:191)**

ACGAAATGCAGGGCAGACAGATGCCTCGCAAATTGAAAAGCGGCAGTTAGCCAAGGAGGAAAAGCAGT  
GAAAAAACAGAAATTAGTAAAGACGCAGACTGCACGAAATTTATCTAGCTGGAGGTTGTTTCTGGGG  
AGTGGAGGAATATTTCTCAGTGTTCCCGGGGTGACGGATGCCGTTTCAGGCTATGCAAATGGTAGAGG  
AGAAACAACCAAGTACGAATTGATTAACCAAAACAGGTCATGCAGAAACCGTCCATGTCACCTATGATGC  
CAAGCAAATTTCTCTCAAGGAAATCCTGCTTCACTATTTCCGCATTATCAATCCAACAGCAAAAATAA  
ACAAGGAAATGATGTGGGGACCCAGTACCGTACTGGTGTATTACACAGATGACAAGGATTTGGAAGT  
GATTAACCAAGTCTTTGATGAGGTGGCTAAGAAATACGATCAACCTCTAGCAGTTGAAAAGGAAAACCTT  
GAAGAATTTTGTGGTGGCTGAGGATTACCATCAAGACTATCTCAAGAAAAATCCAAATGGCTACTGCCA  
TATCAATGTTAATCAGGCGGCCTATCTGTGATGATGCCAGCAAATATCCAAAACCAAGTATGAGGA  
ATTGAAAAAGACCCTGTCACTGAGGAGTATGCAGTTACCCAGGAAAATCAAACAGAACGAGCTTTCTC  
AAACCGTTACTGGGATAAATTTGAATCCGGTATCTATGTGGATATAGCAACTGGGGAACCTCTCTTTTC  
ATCAAAAGACAAATTTGAGTCTGGTTGTGGCTGGCCTAGTTTACCCAACCCATCAGTCCAGATGTTGT  
CACCTACAAGGAAGATAAGTCCTACAATATGACCGGTATGGAAGTGGGAGCCGAGTAGGAGATTCTCA  
CCTTGGGCATGTCTTTACGGATGGTCCACAGGACAAGGGCGGCTTACGTTACTGTATCAATAGCCTCTC  
TATCCGCTTTATTTCCCAAAGACCAAATGGAAGAAAAAGGCTACGCTTATTTACTAGATTATGTTGAT

**SP109 amino acid (SEQ ID NO:192)**

RNAGQTDASQIEKAASVQGGKAVKKTEISKDADLHEIYLAGGCFWGVVEEYFSRVPGVTDVAVSGYANGRG  
ETTKYELINQTHAETVHVITYDAKQISLKEILLHYFRIINPTSKNKQGNVGTQYRTGVVYTDKDLLEV  
INQVFDEVAKKYDQPLAVEKENLKNFVVAEDYHQDYLLKKNPNGYCHINVNQAAYPVIDASKYPKPSDEE  
LKKTLSPPEYAVTQENQTERAFNSRYWDFESGIYVDIATGEPLFSSKDKFESGCGWPSFTQPISPDVV  
TYKEDKSYNMRMEVRSRVGDSHLGHVFTDGPQDKGGLRYCINSLSIRFIPKQMEEEKGYAYLLDYVD

**SP110 nucleotide (SEQ ID NO:193)**

TGTATAGTTTTTAGCGCTTGTTCTTCTAATTCTGNTAAAAATGAAGAAAATACCTTCTAAAGAGCATGCG  
CCTGATAAAATAGTTTTAGATCATGCTTTTCGGTCAAACCTATATTAGATAAAAAACCTGAAAGAGTTGCA  
ACTATTGCTTGGGGAAATCATGATGTAGCATTAGCTTTAGGAATAGTTCCTGTTGGATTTTCAAAGCA  
AATTACGGTGTAAGTGCTGATAAAGGAGTTTTACCATGGACAGAAGAAAAATCAAAGAATAAATGGT  
AAAGCTAACCTATTTGACGATTTGGATGGACTTAACTTTGAAGCAATATCAAATTTCTAAACCAGATGTT  
ATCTTAGCAGGTTATTCTGGTATAACTAAAGAAGATTATGACACTCTATCA

**SP110 amino acid (SEQ ID NO:194)**

CIVFSACSSNSXKNEENTSKEHAPDKIVLDHAFGQTILDKKPERVATIAWGNHDVALGIVPVGFSKA  
NYGVSADKGVLPWTEEKIKELNGKANLFDDLDGLNFEAISNSKPDVILAGYSGITKEDYDTLS

**SP111 nucleotide (SEQ ID NO:195)**

GTGTGTCGAGCATATTCTGAAGCAAACCTATCAAAATATAGAAATTATTTTAGTTGATGACGGTTCTAC  
GGATAATTCTGGGGAAATTTGTGATGCTTTTATGATGCAAGATAATCGTGTGCGAGTATTGCATCAAGA  
AAATAAGGGGGGGGAGCACAAGCTAAAAATATGGGGATTAGTGTAGCTAAGGGAGAGTACATCAGGAT  
TGTTGATTACAGATGATATCGTAAAGAAAAATATGATTGAAACTCTTTATCAGCAAGTCCAAGAAAAGGA  
TGCAGATGTTGTTATAGGGAATTACTATAATTATGACGAAAGTGACGGGAATTTTTATTTTTATGTAAC  
AGGGCAAGATTTTTGCGTCAAGAATTAGCTATACAAGAAATTATGAACCGTCAAGCAGGAGATTGGAA  
ATTCAATAGCTCGGCCTTTATATTGCCGACATTTAAGTTGATTAAAAAAGAATTATTCAATGAAGTTCA  
CTTTTCAAATGGTCGCCGCTTTGATGATGAAGCAACTATGCATCGCTTTTATCTTTTAGCCTCTAAAT  
CGTCTTTATAAACGATAATCTCTATCTGTATAGAAGACGTTTCAGGAAGCATCATGAGAACGGAATTTGA

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Table 1

TCTTTCCTGGGCAAGAGATATTGTTGAAGTGTTCCTAAGAAAATATCGGATTGTGTCTTGGCTGGTTT  
GGATGTCTCCGTTCTGCGTATTGATTTGTCAATCTTTTAAAGATTATAAGCAAACCTTTAGAATACCA  
TCAATTAACAGATACTGAGGAATATAAAGATATTTGTTTCAGATTAAAGTTGTTTTTTGATGCAGAAACA  
AAGAAATGGTAAAAGT

**SP111 amino acid (SEQ ID NO:196)**

CVEHILKQTYQNIIEILVDDGSTDNSGEICDAFMMQDNVRVRLHQENKGGAAQAKNMGISVAKGEYITI  
VDSDDIVKENMIETLYQQVQEKDADVIGNYYNYDESDGNFYFYVTGQDFCVELAIQEIMNRQAGDWK  
FNSSAFILPTFKLIKKELFNEVHFSNGRRFDDEATMHRFYLLASKIVFINDNLYLYRRRSGSIMRTEFD  
LSWARDIVEVFSKKISDCVLAGLDVSVLRIRFVNLLKDYKQTLLEYHQLTDTEEYKDICFRLKLFDAEQ  
RNGKS

**SP0112 nucleotide (SEQ ID NO:197)**

GTGTTTGGATAGCATTCAGAATCAGACGTATCAAAATTTTGAGTGTATTATTAATCAATGATGGCTCTCC  
AGATCATTCATCCAAAATATGTGAAGAATTTGTAGAGAAAGATTCTCGTTTCAAAATTTTGAGAAAGC  
AAACGGCGGTCTTTCATCAGCTCGTAACCTAGGTATTGAATGTTTCGGGGGGGGCGTACATTACTTTTGT  
AGACTCTGATGATTGGTTGGAACATGATGCTTTAGACCGATTATATGGTGCTTTGAAAAAGGAAAACGC  
AGATATTAGTATCGGGCGTTATAATTCTTATGATGAAACACGCTATGTGTATATGACTTATGTTACGGA  
TCCAGATGATTCTCTAGAAGTGATAGAAGGTAAAGCAATTATGGATAGGGAAGGTGTCAAGAAGTCAG  
AAATGGGAACCTGGACTGTAGCTGTCTTGAAGTTATTCAAGAGAGAGTTACTACAAGATTACCATTTC  
TATAGGAAAAATGCAGAGGATACTTACTGGACATGGAAGGTACTTCTAAGAGCTTCGAGGATAGTCTA  
TTTGAATCGTTGTGTTTACTGGTACCGTGTGGTTTATCTGATACTTTATCGAATACATGGAGTGAAAA  
GCGTATGTATGATGAAATTGGGGCTAGGGAAGAAAAGATAGCTATTTTAGCAAGTTCAGACTATGACTT  
GACCAATCATATTTTGATTTATAAAAATAGATTACAAAGAGTGATAGCAAAATTAGAAGAACAAATAT  
GCAGTTCACAGAGATTTACAGAAGATGATGAAAAAATTGTCTTTACTTCCG

**SP0112 amino acid (SEQ ID NO:198)**

CLDSIQNQTYQNFECLLINDGSPDHSSKICEEFVEKDSRFKYFEKANGLSSARNLGI ECGGAYITFV  
DSDDWLEHDALDRLYGALKKENADISIGRYNSYDETRYVYMTYVTDPPDSLEVIEGKAIMDREGVEEVR  
NGNWTVAVLKLFKRELLQDLFPPIGKIAEDTYWTKVLLRASRIVYLNRCVYWYRVGLSDTLNNTWSEK  
RMYDEIGAREEKIAILASSDYDLTNHILYKNRLQRVIAKLEEQNMQFTEIYRRMMEKLSLLP

**SP113 nucleotide (SEQ ID NO:199)**

GTGCCTAGATAGTATTATTACTCAAACATATAAAAAATATTGAGATTGTTGTCTGTTAATGATGGTTCTAC  
GGATGCTTCAGGTGAAATTTGTAAAGAATTTTCAGAAATGGATCACC GAATTCCTATATAGAACAAGA  
AAATGCTGGTCTTTCTGCCGCACGAAACACCGGTCTGAATAATATGTCCGGAATTATGTGACCTTTGT  
GGACTCGGATGATTGGATTGAGCAAGATTATGTAGAACTCTATATAAAAAATAGTAGAGTATCAGGC  
TGATATTGCAGTTGGTAATTATTATTCTTTCAACGAAAGTGAAGGAATGTTCTACTTTTCATATATTGGG  
AGACTCCTATTATGAGAAAGTATATGATAATGTTTCTATCTTTGAGAACTTGTATGAACTCAAGAAAT  
GAAGAGTTTTGCTTTGATATCTGCTTGGGGTAACTCTATAAGGCAAGATTGTTTGAGCAGTTGCGCTT  
TGACATAGGTAAATTAGGAGAAGATGGTTACCTCAATCAAAAGGTATATTTATTATCAGAAAAGGTAAT  
TTATTTAAATAAAAGTCTTTATGCTTATCGGATTAGAAAAGGTAGTTTATCAAGAGTTTGGACAGAAAA  
GTGGATGCACGCTTTAGTTGATGCTATGTCTGAACGTATTACGCTACTAGCTAATATGGGTATCCTCT  
AGAGAAACACTTGGCAGTTTATCGTCAGATGTTGGAAGTCAGTCTCGCCAACGGTCAAGCTAGTGGTTT  
ATCTGACACAGCAACGTATAAAGAGTTTGAAATGAAACAAAGGCTTTTAAATCAGCTATCGAGACAAGA  
GGAAAGTGAAAAGAAAGCCATTGTCTCGCAGCAAACTATGGCTATGTAGACCAAGTTTAAACGACAAT  
CAAGTCTATTTGTTATCATAATCGTTTCGATTGCTTTTATCTGATTATAGCGATTTTCCAAATGAATG  
GATTAAGCAATTAAATAAGCGCTTAGAGAAGTTTGACTCAGAAATTATTAATTGTCGGGTAACCTTCTGA  
GCAAATTTTCAATGTTATAAATCGGATATTAGTTACACAGTCTTTTACGCTATTTTCATAGCTGATTTGCT  
GCAAGAAGACAGAGCCCTCTACTTGGACTGTGATCTAGTTGTAACGAAAAATCTGGATGACTTGTGTTGC  
TACAGACTTACAAGATTATCCTTTGGCTGCTGTTAGAGATTTTGGGGGCAGAGCTTATTTTGGTCAAGA  
AATCTTTAATGCCGGTGTCTCTTGGTAAACAATGCTTTTTTGGAAAAAGAGAATATGACCCAAAAAT  
AATTGATGTAACCAATGAATGGCATGATAAGGTGGATCAGGCAGATCAGAGCATCTTGAATATGCTTTT  
TGAACATAAATGGTTGGAATTGGACTTTGATTATAATCATATTGTCATTATATAACAGTTTGCTGATTA  
TCAATTGCCTGAGGGTCAGGATTATCTGCTATTATTCACTATCTTTCTCATCGAAACCGTGGAAAGA  
TTTGGCGGCCCAAACCTATCGTGAAGTTTGGTGGTACTATCATGGGCTTGAATGGACAGAATTGGGACA  
AAACCATCATTTACATCCATTACAAAGATCTCACATCTATCCAATAAAGGAACCTTTCACTTGTCTAAT  
CTATACTGCCTCAGACCATATTGAACAAATTGAGACATTGGTTCAATCCTTGCCTGATATTCAGTTTAA

Table 1

GATAGCAGCTAGAGTAATAGTTAGTGATCGATTGGCTCAGATGACAATTTATCCAAACGTGACTATATT  
TAACGGAATTCACCTATTTGGTAGATGTCGATAATGAATTGGTAGAAACCAGTCAAGTACTTTTAGATAT  
TAATCATGGCGAAAAGACAGAAGAAATTCTCGATCAATTTGCTAATCTTGGCAAGCCTATCTTATCCTT  
TGAAAATACTAAAACCTATGAAGTAGGTCAGGAGGCATATGCTGTTGACCAAGTTCAAGCAATGATTGA  
AAAATTGAGAGAAATAAGCAA

**SP113 amino acid (SEQ ID NO:200)**

CLDSIITQTYKNIEIVVNDGSTDASGEICKEFSEMDHRILYIEQENAGLSAARNTGLNMSGNYVTFV  
DSDDWIEQDYVETLYKKIVEYQADIAVGNYSFNESEGMYFPHILGDSYIEKVYDNVSIFENLYETQEM  
KSFALISAWGKLYKARLFEQLRFDIGKLGEDGYLNQKVYLLSEKVIYLNKSLYAYRIRKGSLSRVWTEK  
WMHALVDAMSERITLLANMGYPLEKHLAVYRQMLEVSLANGQASGLSDTATYKEFEMKQRLNQLSRQE  
ESEKKAIVLAANYGYVDQVLTTIKSIYHNRSIRFYLIHSDFPNEWIKQLNKRLEKFDSEIINCRVTSE  
QISCYKSDISYTVFLRYFIADVFQEDKALYLDCLVVTKNLDDLDFATDLQDYPLAAVRDFGGRAYFGQE  
IFNAGVLLVNNAFWKKNMTQKLIDVTNEWHDKVDQADQSILNMLFEHKWLELDFDYNHIVIHKQFADY  
QLPEGQDYPALIIHYLSHRKPWKDLAAQTYREVWYYHGLEWTELQGNHHLHPLQRSHIYPIKEPFTCLI  
YTASDHIEQIETLVQSLPDIQFKIARVIVSDRLAQMTIYPNVTIFNGIHVLDVDNELVETSQVLLDI  
NHGEKTEEILDQFANLGKPILSFENTKTYEVGQEAYAVDQVQAMIEKLREISK

**SP114 nucleotide (SEQ ID NO:201)**

CATTCAGAAGCAGACCTATCAAATCTGGAAATTATTCTTGTGATGATGGTGCAACAGATGAAAGTGG  
TCGCTTGTGTGATTCAATCGCTGAACAAGATGACAGGGGTGTCAGTGCTTCATAAAAAGAACGAAGGATT  
GTCGCAAGCACGAAATGATGGGATGAAGCAGGCTCACGGGGATTATCTGATTTTTATTGACTCAGATGA  
TTATATCCATCCAGAAATGATTGAGAGCTTATATGAGCAATTAGTTCAAGAAGATGCGGATGTTTCGAG  
CTGTGGTGTCATGAATGTCTATGCTAATGATGAAAGCCCACAGTCAGCCAATCAGGATGACTATTTTGT  
CTGTGATTCTCAAACATTTCTAAAGGAATACCTCATAGGTGAAAAAATACCTGGGACGATTGCAATAA  
GCTAATCAAGAGACAGATTGCAACTGCCCTATCCTTTCTAAGGGGTGATTACGAAGATGCCTATTA  
CCATTTTGATTTAATCAAGTTGGCCAAGAAGTATGTGGTTAATACTAAACCCTATTATTACTATTTC  
TAGAGGGGATAGTATTACGACCAAACCCTATGCAGAGAAGGATTAGCCTATATTGATATCTACCAAAA  
GTTTTATAATGAAGTTGTGAAAACTATCCTGACTTGAAAGAGGTCGCTTTTTTCAGATTGGCCTATGC  
CCACTTCTTTATTCTGGATAAGATGTTGCTAGATGATCAGTATAAACAGTTTGAAGCCTATTCTCAGAT  
TCATCGTTTTTTAAAGGCCATGCCTTTGCTATTCTAGGAATCCAATTTTCCGTAAGGGGAGAAGAAT  
TAGTGCTTTGGCCCTATTTCATAAATATTTCTTATATCGATTCTTATTACTGAAAAATATTGAAAAATC  
TAAAAAATTACAT

**SP114 amino acid (SEQ ID NO:202)**

IQKQTYQNLEIILVDDGATDESGRLCDSIAEQDDRVSVLHKKNEGLSQARNDBGKQAHGDYLIIFIDSDD  
YIHPMIQSLYEQLVQEDADVSSCGVMNVYANDESPQSANQDDYFVCDSTFLKEYLIGEKIPGTICNK  
LIKRIATALSFPKGLIYEDAYYHFDLIKLAKKYVNTKPYYYYFHRGDSITTKPYAEKDLAYIDIYQK  
FYNEVVKNYPDLKEVAFFRLAYAHFFILDKMLLDDQYKQFEAYSQIHRFLKGHAFISRNPFRKGRRI  
SALALFINISLYRFLLLKNIEKSKKLH

**SP115 nucleotide (SEQ ID NO:203)**

TAAGGCTGATAATCGTGTTCAAATGAGAACGACGATTAATAATGAATCGCCATTGTTGCTTTCTCCGTT  
GTATGGCAATGATAATGGTAACGGATTATGGTGGGGGAACACATTGAAGGGAGCATGGGAAGCTATTCC  
TGAAGATGTAAAGCCATATGCAGCGATTGAACTTCATCCTGCAAAAGTCTGTAAACCAACAAGTTGTAT  
TCCACGAGATACGAAAGAATTGAGAGAATGGTATGTCAAGATGTTGGAGGAAGCTCAAAGTCTAAACAT  
TCCAGTTTTCTTGGTTATTATGTCGGCTGGAGAGCGTAATACAGTTCCTCCAGAGTGGTTAGATGAACA  
ATTCCAAAAGTATAGTGTGTTAAAGGTGTTTAAATATTGAGAATTATTGGATTTACAATAACCAGTT  
AGCTCCGATAGTGTCTAAATATTGGAAAGTTTGTGCCAAATATGGAGCGCATTTTATCTGGCATGATCA  
TGAAAAATGGTTCTGGGAAACTATTATGAATGATCCGACATTCTTTGAAGCGAGTCAAAAATATCATAA  
AAATTTGGTGTGGCAACTAAAAATACGCCAATAAGAGATGATGCGGGTACAGATTCTATCGTTAGTGG  
ATTTTGGTTGAGTGGCTTATGTGATAACTGGGGCTCATCAACAGATACATGGAAATGGTGGGAAAAACA  
TTATACAAACACATTTGAAACTGGAAGAGCTAGGGATATGAGATCCTATGCATCGGAACCAGAATCAAT  
GATTGCTATGGAAATGATGAATGTATATACTGGGGGAGGCACAGTTTATAATTTCGAATGTGCCGCGTA  
TACATTTATGACAAATGATGTACCAACTCCAGCATTTACTAAAGGTATTATTCCTTTCTTTAGACATGC  
TATACAAAATCCAGCTCCAAGTAAGGAAGAAGTTGTAAATAGAACAAAAGCTGTATTTTGAATGGAGA  
AGGTAGGATTAGTTTCAATTAACGGATTTTATCAAGGACTTTATTTCGAATGATGAAACAATGCCTTTATA  
TAATAATGGGAGATATCATATTCTTCTGTAAATACATGAGAAAATTGATAAGGAAAAGATTTTCATCTAT

Table 1

ATTCCTTAATGCAAAAATTTTGACTAAAAATAGTGAGGAATTGTCTAGTAAAGTCAACTATTTAAACTC  
GCTTTATCCAAAACCTTTATGAAGGAGATGGGTATGCTCAGCGTGTAGGTAATTCCTGGTATATTTATAA  
TAGTAATGCTAATATCAATAAAAAATCAGCAAGTAATGTTGCCATGTATATACTAATAATACAAAGTCGTT  
ATCGTTAGATTTGACGCCACATACTTACGCTGTTGTTAAAGAAAATCCAAATAATTTACATATTTTATT  
GAATAATTACAGGACAGATAAGACAGCTATGTGGGCATTATCAGGAAATTTTGATGCATCAAAAAGTTG  
GAAGAAAGAAGAATTAGAGTTAGCGAACTGGATAAGCAAAAATTTATCCATCAATCCTGTAGATAATGA  
CTTTAGGACAACAACACTTACATTAAAAGGGCATACTGGTCATAAACCTCAGATAAATATAAGTGGCGA  
TAAAAATCATTATACTTATACAGAAAATTTGGGATGAGAATACCCATGTTTATACCATTACGGTTAATCA  
TAATGGAATGGTAGAGATGTCTATAAATACTGAGGGGACAGGTCCAGTCTCTTTCCCAACACCAGATAA  
ATTTAATGATGGTAATTTGAATATAGCATATGCAAAACCAACAACACAAAGTTCTGTAGATTACAATGG  
AGACCTTAATAGAGCTGTGGATGGTAACAGAAATGGTAATTTTAACTCTGGTTCCGGTAACACACACTAG  
GGCAGATAATCCCTCTTGGTGGGAAGTCGATTGAAAAAATGGATAAAGTTGGGCTTGTTAAATTTA  
TAATCGCACAGATGCTGAGACTCAACGTCTATCTAATTTT

**SP115 amino acid (SEQ ID NO:204)**

KADNRVQMRTTINNESPLLLSPLYGNDNGNGLWWGNTLKGAWAIPEDVKPYAAIELHPAKVCKPTSCI  
PRDTKELREWYVKMLEEAQSLNIPVFLVIMSAGERNTVPPEWLDEQFQKYSVLKGVNLNIENYWIYNNQL  
APHSAKYLEVCAKYGAHFIWHDHEKWFWETIMNDPTFFEASQKYHKNLVLATKNTPIRDDAGTDSIVSG  
FWLSGLCDNWGSSDTWKWWEKHNTFETGRARDMSYASEPESMIAMEMMNVTGGGTVYNFECAY  
TFMTNDVPTPAFTKGIIPFRHAIQNPAKSKEEVNRTKAVFWNGEGRISLNGFYQGLYSNDETPLY  
NNGRYHILPVIHEKIDKEKISSIFPNAKILTKNSEELSSKVNYLNSLYPKLYEGDGYAQRVGNISWYIYN  
SNANINKNQVMLPMYTNNTKSLSLDLTPHTYAVVKENPNNLHILLNNYRTDKTAMWALSGNFDASKSW  
KKEELELANWISKYNSINPVDNDFRTTTLTLKGHTGHKPOINISGDKNHYTYTENWDENTHVTITVNH  
NGMVEMSIINTEGTGPVSFPTPDKFNDGNLNIAYAKPTTQSSVDYNGDPNRAVDGNRNGNFNSGSVTHTR  
ADNPSWWEVDLKKMDKVGLVKIYNRTDAETQRLSNF

**SP117 nucleotide (SEQ ID NO:205)**

CTGTGGCAATCAGTCAGCTGCTTCCAAACAGTCAGCTTCAGGAACGATTGAGGTGATTTACAGAGAAAA  
TGGCTCTGGGACACGGGGTGCCTTCACAGAAATCAGAGGATTCTCAAAAAGACGGTGATAAAAAAAT  
TGACAACACTGCCAAAACAGCTGTGATTCAAATAGTACAGAAGGTGTTCTCTCAGCAGTTCAAGGGAA  
TGCTAATGCTATCGGCTACATCTCCTTGGGATCTTTAACGAAATCTGTCAAGGCTTTAGAGATTGATGG  
TGTCAGGCTAGTCGAGACACAGTTTTAGATGGTGAATACCCCTCTTCAACGTCCCTTCAACATTGTTTG  
GTCTTCTAATCTTTCCAAGCTAGGTCAAGATTTTATCAGCTTTATCCACTCCAAACAAGGTCAACAAGT  
GGTCACAGATAATAAATTTATTGAAGCTAAAACCGAAACCACGGAATATACAAGCCAACACTTATCAGG  
CAAGTTGTCTGTTGTAGGTTCCACTTCAGTATCTTCTTTAATGGAAAAATTAGCAGAAGCTTATAAAAA  
AGAAAATCCAGAAGTTACGATTGATATTACCTCTAATGGGTCTTCAGCAGGTATTACCGCTGTTAAGGA  
GAAAACCGCTGATATTGGTATGGTTTCTAGGGAATTAACCTCTGAAGAAGGTAAGAGTCTCACCCATGA  
TGCTATTGCTTTAGACGGTATTGCTGTTGTGGTCAATAATGACAATAAGGCAAGCCAAGTCAGTATGGC  
TGAAGTTGCAGACGTTTTTAGTGGCAAATTAACCACCTGGGACAAGATTAA

**SP117 amino acid (SEQ ID NO:206)**

CGNQSAASKQSASGTIEVISRENGSGTRGAFTEITGILKKDGDKKIDNTAKTAVIQNSTEGVLSAVQGN  
ANAIGYISLGS�TKSVKALEIDGVKASRDVLDGEYPLQRPFNIVWSSNLSKLGQDFISFIHSKQGQOV  
VTDNKFIEAKTETTEYTSQHLSGKLSVVGSTSVSSLMEKLAAYKKENPEVTIDITSNGSSAGITAVKE  
KTADIGMVSRELTPPEGKSLTHDAIALDGIADVNNNDNKASQVSMALADVFSGLTTWDKIK

**SP118 nucleotide (SEQ ID NO:207)**

TTGTCAACAACAACATGCTACTTCTGAGGGGACGAATCAAAGGCAAAGCAGTTACGCGAAAGTTCCATG  
GAAAGCTTCATACACCAACCTAAACAACCAGGTAAGTACAGAAGAGGTCAAATCTCTCTTATCAGCTCA  
CTTGGATCCAAATAGTGTGATGCATTTTTTAATCTCGTTAATGACTATAATACCATTGTCTGGCTCAAC  
TGGCTTATCAGGAGATTTCACTTCCTTTACTCACACCGAATACGATGTTGAGAAAATCAGTCATCTCTG  
GAATCAAAGAAGGGCGATTTTGTGGGACCAACTGCCGTATCAATAGTTATTGTCTTTTGAAAAATTC  
AGTCACCATTTCAAAGCTTGAAAAGAATGACCAGTTGCTTTTCTAGATAATGATGCGATTGATAAAGG  
AAAGGTCTTTGATTACACAAGATAAGGAAGAGTTTGATATTCTATTTTCGAGAGTTCCAAGTGAAGTCAAC  
TACAGATGTCAAGGTTACAGCTGAAAAGATGGAAGCATCTTCTCACAATTTCAATTCAATGAAAAAGC  
TCGAATGCTGTCTGTAGTCTTGCACGACAATTTGGATGGCGAGTATCTGTTTGTAGGCCACGTTGGGGT  
CTTAGTACCTGCTGATGACGGTTTCTTATTTGTAGAGAAATGACTTTTCAAGAGCCCTACCAAGCGAT

Table 1

91

TAAATTTGCTAGTAAGGAAGATTGCTACAAGTATTTGGGCACCAAGTATGCGGATTATACAGGCGAGGG  
ACTGGCTAAGCCTTTTATCATGGATAATGATAAGTGGGTAAACTT

**SP118 amino acid (SEQ ID NO:208)**

CQQQHATSEGTNQRQSSSAKVPWKASYTNLNNQVSTEEVKSLLSAHLDPNSVDAFFNLVNDYNTIVGST  
GLSGDFTSFTHTEYDVEKISHLWNQKKGDFVGTNCRINSYCLLKNSVTIPKLEKNDQLFLDNDIDAIDKG  
KVFDSQDKEEFDILFSRVPTESTTDVKVHAEKMEAFFSQFQFNEKARMLSVVLHDNLDGEYLFVGHVGV  
LVPADDGFLFVEKLTFFPEYQAIKFASKEDCYKYLGTKYADYTGEGLAKPFIMDNDKWVKL

**SP119 nucleotide (SEQ ID NO:209)**

TTGTTTCAGGCAAGTCCGTGACTAGTGAACACCAAACGAAAGATGAAATGAAGACGGAGCAGACAGCTAG  
TAAACAAGCGCAGCTAAAGGGAAAGAGGTGGCTGATTTTGAAATGATGGGAGTAGATGGCAAGACCTA  
CCGTTTATCTGATTACAAGGGCAAGAAAGTCTATCTCAAATCTGGGCTTCTTGGTGTTCATCTGTCT  
GGCTAGTCTTCCAGATACGGATGAGATTGCTAAAGAAGCTTGAAGATTTAAGAAATGGTATAAGGGATTGGATTATAA  
AAATCTCCCAGTCCAGTTGACCATCAGGCAAACCTTTTGAAACTTATGGTGTCCGTTCTTACCCAAC  
CCAAGCCTTTATAGACAAAGAAGGCAAGCTGGTCAAAACACATCCAGGATTTCATGGAAAAAGATGCAAT  
TTTGCAAACCTTTGAAGGAATTAGCC

**SP119 amino acid (SEQ ID NO:210)**

CSGKSVTSEHQTKDEMKTETASKTSAAKGKEVADFELMGVDGKTYRLSDYKGGKVYLKFWASWCISICL  
ASLPDTDEIAKEAGDDYVVLTVVSPGHKEQSEADFKNWYKGLDYKNLPVLVDPGKLLLEYGVRSYPT  
QAFIDKEGKLVKTHPGFMEKDAILQTLKELA

**SP120 nucleotide (SEQ ID NO:211)**

CTCGCAAATTGAAAAGGCGGCAGTTAGCCAAGGAGGAAAAAGCAGTGAAAAAACAGAAATTAGTAAAGA  
CGCAGACTTGCACGAAATTTATCTAGCTGGAGGTTGTTTCTGGGGAGTGGAGGAATATTTCTCACGTGT  
TCCCGGGGTGACGGATGCCGTTTCAGGCTATGCAAATGGTAGAGGAGAAACAACCAAGTACGAATTGAT  
TAACCAAACAGGTCATGCAGAAACCGTCCATGTCACCTATGATGCCAAGCAAATTTCTCTCAAGGAAAT  
CCTGCTTCACTATTTCCGCATTATCAATCCAACCAAGCAAAAAATAACAAGGAAATGATGTGGGGACCCA  
GTACCGTACTGGTGTTTATTACACAGATGACAAGGATTGGAAGTGATTAACCAAGTCTTTGATGAGGT  
GGCTAAGAAATACGATCAACCTCTAGCAGTTGAAAAGGAAAACTTGAAGAATTTTGTGGTGGCTGAGGA  
TTACCATCAAGACTATCTCAAGAAAAATCCAAATGGCTACTGCCATATCAATGTTAATCAGGCGGCCTA  
TCCTGTCAATTGATGCCAGCAAATATCCAAAACCAAGTGATGAGGAATTGAAAAAGACCCGTGTACCTGA  
GGAGTATGCAGTTACCCAGGAAAATCAAACAGAACGAGCTTTCTCAAACCGTTACTGGGATAAAATTTGA  
ATCCGGTATCTATGTGGATATAGCAACTGGGGAACCTCTCTTTTCATCAAAAGACAAATTTGAGTCTGG  
TTGTGGCTGGCCTAGTTTTACCCAACCCATCAGTCCAGATGTTGTCACCTACAAGGAAGATAAGTCCTA  
CAATATGACGCGTATGGAAGTGCGGAGCCGAGTAGGAGATTCTCACCTTGGGCATGTCTTTACGGATGG  
TCCACAGGACAAGGGCGGCTTACGTTACTGTATCAATAGCCTCTCTATCCGCTTTATTCCCAAAGACCA  
AATGGAAGAAAAAGGTACGCTTATTTAC

**SP120 amino acid (SEQ ID NO:212)**

SQIEKAAVSQGGKAVKKTEISKDADLHEIYLAGGCFWGVVEEYFSRVPGVTDVSGYANGRGETTKYELI  
NQTHAETVHVTYDAKQISLKEILLHYFRIINPTSKNQKQNDVGTQYRTGVYYTDDKDLEVINQVFDEV  
AKKYDQPLAVEKENLKNFVVAEDYHQDYLLKKNPNGYCHINVNQAAYPVIDASKYPKPSDEELKKTLSPE  
EYAVTQENQTERAFSNRYWDFESGIYVDIATGEPLFSSKDKFESGCGWPSFTQPISPDVVITYKEDKSY  
NMTRMEVRSRVGDSHLGHVFTDGPQDKGLRYCINSLSIRFIPKQMEKGTLIY

**SP121 nucleotide (SEQ ID NO:213)**

TTGTCAAGTCAGGTTCTAATGGTTCTCAGTCTGCTGTGGATGCTATCAAAACAAAAGGGAAATTAGTTGT  
GGCAACCAGTCTGACTATGCACCTTTTGAATTTCAATCATTGGTTGATGGAAAGAACCAGGTAGTCGG  
TGCAGACATCGACATGGCTCAGGCTATCGCTGATGAACTTGGGGTTAAGTTGGAAATCTCAAGCATGAG  
TTTTGACAATGTTTTGACCAGTCTTCAAACCTGGTAAGGCTGACCTAGCAGTTGCAGGAATTAGTGCTAC  
TGACGAGAGAAAAGAAGTCTTTGATTTTTCAATCCCATACTATGAAAACAAGATTAGTTTCTTGGTTTCG  
TAAGGCTGATGTGGAAAAATACAAGGATTTAACTAGCCTAGAAAGTGCTAATATTGCAGCCCCAAAAGG  
GACTGTTCCAGAATCAATGGTCAAGGAACAATTGCCAAAAGTTCAATTAACCTCCCTAACTAATATGGG  
TGAAGCAGTCAATGAATTGCAGGCTGGAAAAATAGATGCTGTTTCATATGGATGAGCCTGTTGCACCTAG

09765272.012201

Table 1

92

TTATGCTGCTAAAAACGCTGGCTTAGCTGTGCGCAACTGTCAGCTTGAAGATGAAGGACGGCGACGCCAA  
TGCC

**SP121 amino acid (SEQ ID NO:214)**

CQSGSNGSQSAVDAIKQKGLVVATSPDYAPFEFQSLVDGKNQVVGADIDMAQAIADDELGVKLEISSMS  
FDNVLTSLOTGKADLAVAGISATDERKEVDFDSIPYENKISFLVRKADVEKYKDLTSLESANIAAQKG  
TVPESMVKEQLPKVQLTSLTNMGEAVNELQAGKIDAVHMDPEVALSYAAKNAGLAVATVSLKMKDGDAN  
A

**SP122 nucleotide (SEQ ID NO:215)**

GGAACTTCACAGGATTTTAAAGAGAAGAAAACAGCAGTCATTAAGGAAAAAGAAGTTGTTAGTAAAAA  
TCCTGTGATAGACAATAACACTAGCAATGAAGAAGCAAAAATCAAAGAAGAAAATTCGAATAAATCCCA  
AGGAGATTATACGGACTCATTTGTGAATAAAAACACAGAAAATCCCAAAAAAGAAGATAAAGTTGTCTA  
TATTGCTGAATTTAAAGATAAAGAATCTGGAGAAAAAGCAATCAAGGAACATATCCAGTCTTAAGAATAC  
AAAAGTTTATATACTTATGATAGAATTTTAAACGGTAGTGCCATAGAAACAACCTCCAGATAACTTGGA  
CAAAATTTAAACAAATAGAAGGTATTTTCATCGGTTGAAAGGGCACAAAAAGTCCAACCCATGATGAATCA  
TGCCAGAAAGGAAATTGGAGTTGAGGAAGCTATTGATTACCTAAAGTCTATCAATGCTCCGTTTGGGAA  
AAATTTTGATGGTAGAGGTATGGTCATTTCAAATATCGATACTGGAACAGATTATAGACATAAGGCTAT  
GAGAATCGATGATGATGCCAAAGCCTCAATGAGATTTAAAAAGAAGACTTAAAAGGCACTGATAAAAA  
TTATTGGTTGAGTGATAAAATCCCTCATGCGTTCAATTATTATAATGGTGGCAAAATCACTGTAGAAAA  
ATATGATGATGGAAGGGATTATTTTGACCCACATGGGATGCATATTGCAGGGATTCTTGCTGGAAATGA  
TACTGAACAAGACATCAAAAACCTTAAACGGCATAGATGGAATTGCACCTAATGCACAAATTTTCTCTTA  
CAAAATGTATTCTGACGCAGGATCTGGGTTTGCAGGATGATGAAACAATGTTTCATGCTATTGAAGATTC  
TATCAACACAACGTTGATGTTGTTTCCGTTATCATCTGGTTTACAGGAACAGGTCTTGTTAGGTGAGAA  
ATATTGGCAAGCTATTCGGGCATTAAGAAAAGCAGGCATTCGAATGGTTGTCGCTACGGGTAACATATGC  
GACTTCTGCTTCAAGTTCTTCATGGGATTTAGTAGCAAAATAATCATCTGAAAATGACCGACACTGGAAA  
TGTAACACGAACCTGCAGCACATGAAGATGCGATAGCGGTCGCTTCTGCTAAAAATCAAACAGTTGAGTT  
TGATAAAGTTAACATAGGTGGAGAAAAGTTTAAATACAGAAATATAGGGGCCCTTTTTCGATAAGAGTAA  
AATCACAACAAATGAAGATGGAACAAAAGCTCCTAGTAAATTTAAATTTGTATATATAGGCAAGGGGCA  
AGACCAAGATTTGATAGGTTTGGATCTTAGGGGCAAAATTCAGTAATGGATAGAATTTATACAAAGGA  
TTTAAAAAATGCTTTTAAAAAAGCTATGGATAAGGGTGCACGCGCCATTATGGTTGTAAATACTGTAA  
TTACTACAATAGAGTAATTTGGACAGAGCTTCCAGCTATGGGATATGAAGCGGATGAAGGTACTAAAAG  
TCAAGTGTTTTCAATTTTCAGGAGATGATGGTGTAAGCTATGGAACATGATTAATCCTGATAAAAAAAC  
TGAAGTCAAAAGAAATAATAAAGAAGATTTTAAAGATAAATTTGGAGCAATACTATCCAATTGATATGGA  
AAGTTTAAATTTCAACAAACCGAATGTAGGTGACGAAAAAGAGATTGACTTTAAGTTTGCACCTGACAC  
AGACAAAGAACCTCTATAAAGAAGATATCATCGTTCCAGCAGGATCTACATCTTGGGGGCCAAGAATAGA  
TTTACTTTTAAACCCGATGTTTCAGCACCTGGTAAAAATATTAAATCCACGCTTAATGTTATTAATGG  
CAAATCAACTTATGGCTATATGTCAGGAAGTAGTATGGCGACTCCAATCGTGGCAGCTTCTACTGTTTT  
GATTAGACCGAAATTAAGGAAATGCTTGAAAGACCTGTATTGAAAAATCTTAAGGGAGATGACAAAAT  
AGATCTTACAAGTCTTACAAAATTTGCCCTACAAAATACTGCGCGACCTATGATGGATGCAACTTCTTG  
GAAAGAAAAAAGTCAATACTTTGCATCACCTAGACAACAGGGAGCAGGCCTAATTAATGTGGCCAATGC  
TTTGAGAAATGAAGTTGTAGCAACTTTCAAAAACACTGATTCTAAAGGTTTGGTAAACTCATATGGTTC  
CATTTCTCTTAAAGAAATAAAAGGTGATAAAAAATACTTTACAATCAAGCTTCACAATACATCAAACAG  
ACCTTTGACTTTTAAAGTTTCAGCATCAGCGATAACTACAGATTCTCTAAGTACAGATTAAACTTGA  
TGAAACATATAAAGATGAAAAATCTCCAGATGGTAAGCAAAATTTGTTCCAGAAATTCACCCAGAAAAAGT  
CAAAGGAGCAAATATCACATTTGAGCATGATACTTTCACTATAGGCGCAAATTCAGCTTTGATTGAA  
TGCGGTTATAAATGTTGGAGAGGCCAAAAACAAAAATAAATTTGTAGAATCATTATTATTTGAGTC  
AGTGAAGCGGATGGAAGCTCTAAACTCCAGCGGAAGAAATAAACTTCCAACCTTCTTTGTCGATGCC  
TCTAATGGGATTGCTGGGAATTTGGAACACGAACCAATCCTTGATAAATGGGGCTTGGGAAGAAGGGTC  
AAGATCAAAAACACTGGGAGGTTATGATGATGATGGTAAACCGAAAAATTCAGGAACCTTAAATAAGGG  
AATTGGTGGAGAACATGGTATAGATAAATTTAATCCAGCAGGAGTTATACAAAATAGAAAAGATAAAAA  
TACAACATCCCTGGATCAAAATCCAGAATTATTTGCTTTCAATAACGAAGGGATCAACGCTCCATCATC  
AAGTGGTTCTAAGATTGCTAACATTTATCCTTTAGATTCAAATGGAAATCCTCAAGATGCTCAACTTGA  
AAGAGGATTAACACCTTCTCCACTTGTATTAAGAAGTGCAGAAGAAGGATTGATT

**SP122 amino acid (SEQ ID NO:216)**

ETSQDFKEKKTAVIKEKEVVSKNPVIDNNTSNEEAKIKEENSNSQGDYTDSEFVNKNTENPKKEDKVY  
IAEFKDKESGEKAIKELSSLKNTKVLYTYDRIFNGSAIETTPDNLDKIKQIEGISSVERAQKVQPMNH

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Table 1

ARKEIGVEEAIDYLK SINAPFGKNFDGRGMVISNIDTGTDIRHKAMRIDDDAKASMRFKKEDLKGTDKN  
 YWLSDKIPHAFNYNGGKITVEKYDDGRDYFDPHGMHIAGILAGNDTEQDIKNFNGIDGIAPNAQIFSY  
 KMYSDAGSGFAGDETMFHAIEDSIKHNVDVSVSSGFTGTGLVGEKYWQAIRALRKAGIPMVVATGNYA  
 TSASSSSWDLVANNHLKMTDTGNVTRTA AHEDA IAVASAKNQTVEFDKVNIGGESFKYRNIGAFFDKSK  
 ITTNEGDGTKAPSKLKFVYIGKGQDQDLIGLDLRGKIAVMDRIYTKDLKNAFKKAMDKGARAIMVVNTVN  
 YYNRDNWTELPAMGYEADGKTSQVFSISGDDGVKLWNMINPDKKTEVKRNNKEDFKDKLEQYYPIDME  
 SFNSNKPNGVDEKEIDFKFAPDTEKELYKEDIIVPAGSTSWGPRIDLLKPDVSAPGKNIKSTLNVING  
 KSTYGYMSGTSMATPIVAASTVLIRPKLKEMLERPVLKNLKGDDKIDLTSLTKIALQNTARPMMDATSW  
 KEKSQYFASPRQOGAGLINVANALRNEVVATFKNTDSKGLVNSYGSISLKEIKGDKKYFTIKLHNTSNR  
 PLTFKVSASAITTDSLTDRLKLDETYKDEKSPDGKQIVPEIHPEKVKGANITFEHDTFTIGANSSFDLN  
 AVINVGEAKNKNKFVESFIHFESVEAMEALNSSGKKINFQPSLSMPLMGFAGNWNHEPILDKWAWEEGS  
 RSKTLGGYDDDGKPKIPGTLNKGIGGEHGIDKFNPAQVQNRKDKNTTSLDQNPFLFAFNNEGINAPSS  
 SGSKIANIYPLDSNGNPQDAQLERGLTPSPLVLRSAEEGLI

## SP123 nucleotide (SEQ ID NO:217)

TGTGGTCAAGTTGAGACTCCTCAATCAATAACAAATCAGGAGCAAGCTAGGACAGAAAACCAAGTAGT  
 AGAGACAGAGGAAGCTCCAAAAGAAGAAGCACCTAAAACAGAAGAAAGTCCAAAGGAAGAACCAAAATC  
 GGAGGTAAAACCTACTGACGACACCTTCTCTAAAGTAGAAGAGGGGAAAGAAGATTTCAGCAGAACCAGC  
 TCCAGTTGAAGAAGTAGGTGGAGAAGTTGAGTCAAAACCAGAGGAAAAAGTAGCAGTTAAGCCAGAAAG  
 TCAACCATCAGACAAACCAGCTGAGGAATCAAAAGTTGAACAAGCAGGTGAACCAGTCGCGCCAAGAGA  
 AGACGAAAAGGCACCAGTCGAGCCAGAAAAGCAACCAGAAGCTCCTGAAGAAGAGAAGGCTGTAGAGGA  
 AACACCGAAACAAGAAGAGTCAACTCCAGATACCAAGGCTGAAGAACTGTAGAACCAAAAGAGGAGAC  
 TGTTAATCAATCTATTGAACAACCAAAAGTTGAAACGCCTGCTGTAGAAAAACAAACAGAACCAACAGA  
 GGAACCAAAAGTTGAACAAGCAGGTGAACCAGTCGCGCCAAGAGAAGACGAACAGGCACCAACGGCACC  
 AGTTGAGCCAGAAAAGCAACCAGAAGTTCTCTGAAGAAGAGAAGGCTGTAGAGGAAACACCGAAACAGAG  
 AGATAAAATAAAGGTATTGGTACTAAAGAACCAGTTGATAAAAGTGAGTTAAATAATCAAATTGATAA  
 AGCTAGTTCAAGTTTCTCTACTGATTATTCTACAGCAAGTTACAATGCTCTTGGACCTGTTTTAGAAAC  
 TGCAAAAGGTGTCTATGCTTCAGAGCCTGTAAAACAGCCTGAGGTAAATAGCGAGACAAATAAACTTAA  
 AACGGCTATTGACGCTCTAAACGTTGATAAACTGAATTAACAATACGATTGCAGATGCAAAAACAAA  
 GGTAAAAGAACATTACAGTGATAGAAGTTGGCAAAACCTCCAACTGAAGTTACAAAGGCTGAAAAAGT  
 TGCAGCTAATACAGATGCTAAACAAAGTGAAGTTAACGAAGCTGTTGAAAAATTAAGTCAACTATTGA  
 AAAATTGGTTGAATTATCTGAAAAGCCAATATTAACTTACTAGTACCGATAAGAAAATATTGGAACG  
 TGAAGCTGTTGCTAAGTATACTCTAGAAAATCAAAACAAAACAAAATCAAATCAATCACAGCTGAATT  
 GAAAAAAGGAGAAGAAGTTATTAATACTGTAGTCTTACAGATGACAAGGTAACAACAGAACTATAAG  
 CGCTGCATTTAAGAACCTAGAGTACTACAAAAGAAATACACCCTATCTACAACATGATTTACGACAGAGG  
 TAACGGTGAAGAACTGAACTCTAGAAAATCAAAATATTCAATTAGATCTTAAAAAAGTTGAGCTTAA  
 AAATATTAAACGTACAGATTTAATCAAATACGAAAATGGAAAAGAACTAATGAATCACTGATAACAAC  
 TATTCCTGATGATAAGAGCAATTATTATTAAAAATAACTTCAAATAATCAGAAAACCTACATTACTAGC  
 TGTTAAAAATATAGAAGAACTACGGTTAACGGAACACCTGTATATAAAGTTACAGCAATCGCAGACAA  
 TTTAGTCTCTAGAAGTCTGATAATAAATTTGAAGAAGAA

## SP123 amino acid (SEQ ID NO:218)

VVEVETPQSITNQEQARTENQVVETEEAPKEEAPKTEESPKKEPKSEVKPTDDTLPKVEEGKEDSAEPA  
 PVEEVGGEVESKPEEKVAVKPESQPSDKPAEESKVEQAGEPVAPREDEKAPVEPEKQPEAPEEEKAVEE  
 TPKQEESTPDTKAEETVEPKEETVNQSIQPKVETPAVEKQTEPTEEPKVEQAGEPVAPREDEQAPTAP  
 VEPEKQPEVPKEEKAVEETPKPEDKIKGIGTKPEVDKSELNNQIDKASSVSPTDYSTASYNALGPVLET  
 AKGVYASEPVKQPEVNSETNKLKTAIDALNVDKTELNNIADAKTKVKEHYSDRSWQNLQTEVTKAEKV  
 AANTDAKQSEVNEAVEKLTIATIEKLVELSEKPIILTLTSTDKKILEREAVAKYTLENQNKTKIKSITAE  
 LKKEEVINTVLTDDKVTETISAAFNLEYKEYTLSTTMIYDRNGEETETLENQNIQLDLKKVELK  
 NIKRTDLIKYENGKETNESLITTIPDDKSNNYLLKITSNNQKTLLAVKNIEETTVNGTPVYKVTAIADN  
 LVSRTADNKFEEE

## SP124 amino acid (SEQ ID NO:219)

AACACCTGTATATAAAGTTACAGCAATCGCAGACAATTTAGTCTCTAGAAGTCTGATAATAAATTTGA  
 AGAAGAATACGTTCACTATATTGAAAAACCTAAAGTCCACGAAGATAATGTATATTATAATTTCAAAGA  
 ATTAGTGGAAGCTATTCAAACGATCCTTCAAAGAATATCGTCTGGGACAATCAATGAGCGCTAGAAA  
 TGTTGTTCTTAATGGAAGAAATCATATATCACTAAAGAATTCACAGGAAAACCTTTTAAGTTCTGAAGGAAA  
 ACAATTTGCTATTACTGAATTGGAACATCCATTATTTAATGTGATAACAAACGCAACGATAAATAATGT

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Table 1

GAATTTTGAATGTAGAGATAGAACGTTCTGGTCAAGATAATATTGCATCATTAGCCAATACTATGAA  
AGGTTCTTCAGTTATTACAAATGTCAAATTACAGGCACACTTTCAGGTCGTAATAATGTTGCTGGATT  
TGTAATAATATGAATGATGGAACCTCGTATTGAAAATGTTGCTTTCTTTGGCAAACCTACACTCTACAAG  
TGGAAATGGCTCTCATACAGGGGGAATTGCAGGTACAACTATAGAGGAATTGTTAGAAAAGCATATGT  
TGATGCTACTATTACAGGAAACAAAACACGCGCCAGCTTGTTAGTTCCTAAAGTAGATTATGGATTAAC  
TCTAGACCATCTTATTGGTACAAAAGCTCTCCTAACTGAGTCGGTTGTAAGGTAAATAGATGTTTC  
AAATCCAGTAGAAGTTGGAGCAATAGCAAGTAAGACTTGGCCTGTAGGTACGGTAAGTAATTCTGTCAG  
CTATGCTAAGATTATCCGTGGAGAGGAGTTATTCGGCTCTAACGACGTTGATGATTCTGATTATGCTAG  
TGCTCATATAAAAGATTTATATGCGGTAGAGGGATATTCGTCAGGTAATAGATCATTTAGGAAATCTAA  
AACATTTACTAAATTAACATAAGAAACAAGCTGATGCTAAAGTTACTACTTTCAATATTACTGCTGATAA  
ATTAGAAAGTGATCTATCTCTCTTGCAAAACCTTAATGAAGAAAAGCCTATTCTAGTATTCAAGATTA  
TAACGCTGAATATAACCAAGCCTATAAAAATCTTGAAAAATTAATACCATTCTACAATAAAGATTATAT  
TGATATCAAGGTAATAAATAAATAAAGAACACCATCTAAATACTAAAGAAGTTCTTTCTGTTACCGC  
GATGAACAACAATGAGTTTATCACAAACCTAGATGAAGCTAATAAAAATTATTGTTTACTATGCGGACGG  
TACAAAAGATTACTTTAACTTGTCTTCTAGCAGTGAAGGTTTAAAGTAATGTAAAAGAATATACTATAAC  
TGACTTAGGAATTAATATACACCTAATATCGTTCAAAAAGATAACACTACTCTTGTTAATGATATAAA  
ATCTATTTTAGAATCAGTAGAGCTTCAGTCTCAAACGATGTATCAGCATCTAAATCGATTAGGTGACTA  
TAGAGTTAATGCAATCAAAGATTTATATTTAGAAGAAAGCTTCACAGATGTTAAAGAAAACCTTAACAAA  
CCTAATCAAAAATTAGTTCAAACGAAGAACATCAACTAAATGATTCTCCAGCTGCTCGTCAAATGAT  
TCGTGATAAAGTCGAGAAAAACAAAGCAGCTTTATTACTAGGTTTAACTTACCTAAATCGTTACTATGG  
AGTTAAATTTGGTGATGTTAATATTAAAGAATTAATGCTATTCAAACCAGATTTCTATGGTGAAAAAGT  
TAGCGTATTAGACAGATTAATTGAAATCGGTTCTAAAGAGAACAACATTAAAGGTTACGTACATTCTGA  
CGCATTCCGGTCAAGTA

**SP124 amino acid (SEQ ID NO:220)**

TPVYKVTAIADNLVSRTADNKFEEYVHYIEKPKVHEDNVYYNFKELVEAIQNDPSKEYRLGQSMSARN  
VVPNGKSYITKEFTGKLLSSEKQFAITELEHPLFNVITNATINNVPNFENVEIERSGQDNIASLANTMK  
GSSVITNVKITGTLGRNNVAGFVNMNDGTRIENTVAFFGKLHSTSGNGSHTGGIAGTNYPGIVRKAYV  
DATITGNKTRASLLVPKVDYGLTLDLHIGTKALLTSSVVKGKIDVSNPVEVGAIASCTWPGVTVNSVS  
YAKIIRGEELFGSNDVDDSDYASAHIKDLAYEGYSSGNRSFRKSKTFTKLTKAQADAKVTFNITADK  
LESIDLSPALKNEEKYASSIQDYNAEYNQAYKNLEKLI PFYNKDYIVYQGNKLNKEHHLNLTKEVLSVTA  
MNNNEFITNLDEANKIIVHYADGTDYFNLSSSSEGLSNVKEYTITDLGIKYTPNIVQKDNTTLVNDIK  
SILESVELQSQTMYQHLNRLGDYRVNAIKDLYLEESFTDVKENLTNLITKLVQNEEHQLNDSPAARQMI  
RDKVEKNKAALLLGLTYLNRYYGVKFGDVNIKELMLFKPDFYGEKVSVLDRLEIGSKENNIKGSRTFD  
AFGQV

**SP125 nucleotide (SEQ ID NO:221)**

ATTAGACAGATTAATTGAAATCGGTTCTAAAGAGAACAACATTAAAGGTTACGTACATTTCGACGCATT  
CGGTCAAGTATTGGCTAAATATACTAAATCAGGTAATTTAGATGCATTTTAAATTATAATAGACAATT  
GTTCAAAATATAGACAATATGAACGATTGGTTTATTGATGCTACAGAAGACCATGTCTACATCGCAGA  
ACGCGCTTCTGAGGTGGAAGAAATTAATAATCTTAAACATCGTGATTCGATAATTTAAACGAAGTCA  
CCTTAGAAATACTATACTCCCACTACTGAATATTGATAAAGCACATCTTTATTTAATTTCAAATTATAA  
TGCAATTGCCTTTGGTAGTGACAGCGATTAGGTAAAAAATCATTAGAAGATATTAAAGATATCGTTAA  
CAAAGCTGCAGATGGTTATAGAACTATTATGATTTCTGGTATCGTCTAGCGTCTGATAACGTTAAACA  
ACGACTACTAAGAGATGCTGTTATTCCTATTGGGAAGGTTATAACGCTCCTGGTGGATGGGTTGAAAA  
ATTATGGCCGTATAATACCGACAAAGTATATACTCCTTAGAGAATTCTTTGGTCTATGGATAAGTA  
TTATAATTATAATGGAACAGGAGCTTATGCTGCTATATATCCTAATCTGATGATATTAGAAGTATGAT  
AAAATATGTTTCAATTTAGAAATGGTTGGTGAATACGGTATTTTCACTTTACACACATGAAACAACACAGT  
CAACGACCGTGCGATTTACTTAGGTGGCTTTGGACACCGTGAAGGTACTGATGCTGAAGCATATGCTCA  
GGGTATGCTACAACTCCTGTTACTGGTAGTGGATTTGATGAGTTTGGTTCTTTAGGTATTAATATGGT  
ATTTAAACGCAAAATGATGGGAATCAGTGGTATATTACAGATCCAAAACTCTAAAAACACGAGAAGA  
TATTAATAGATATATGAAGGGTTATAATGACACTTTAACTCTTCTTGATGAAATTGAGGCTGAATCTGT  
GATTTCTCAACAAAATAAAGATTTAAATAGTGCATGGTTCAAAAAATAGATAGAGAATACCGTGATAA  
CAATAAATTAAATCAATGGGATAAAATTCGAAATCTAAGTCAAGAAGAGAAAAATGAATTAAATATTCA  
ATCTGTTAATGATTTAGTTGATCAACAATTAATGACTAATCGCAATCCAGGTAATGGTATCTATAAACC  
CGAAGCAATTAGCTATAACGATCAATCACCTTATGTAGGTGTTAGAATGATGACCGGTATCTACGGAGG  
TAATACTAGTAAAGGTGCTCCTGGAGCTGTTTCATTCAAACATAATGCTTTTAGATTATGGGGTTACTA  
CGGATACGAAAATGGGTTCTTAGGTTATGCTTCAAATAAATAAACAACAATCTAAACAGATGGTGA

Table 1

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GTCTGTTCTAAGTGATGAATATATTATCAAGAAAATATCTAACAATACATTTAATACTATTGAAGAATT  
TAAAAAAGCTTACTTCAAGAAGTTAAAGATAAAGCAACGAAAGGATTAACAACATTTCGAAGTAAATGG  
TTCTTCCGTTTCATCATACGATGATTTACTGACATTGTTTAAAGAAGCTGTTAAAAAAGATGCCGAAAC  
TCTTAAACAAGAAGCAAACGGTAATAAAACAGTATCTATGAATAATACAGTTAAATTAAAAGAAGCTGT  
TTATAAGAAACTTCTTCAACAAACAAATAGCTTTAAAACTTCAATCTTTAA

**SP125 amino acid (SEQ ID NO:222)**

LDRLIEIGSKENNIKSRFTDAFGQVLAKYTKSGNLDNFLNRYQLFTNIDNMNDWFDATEDHVYIAE  
RASEVEEIKNSKHRAFDNLKRSHLRNTILPLLNIDKAHLYLISYNAIAFGSAERLGKKSLEDIKDIVN  
KAADGYRNYDFWYRLASDNVQRLRLRDAVIPIWEGYNAPGGWVEKYGRYNTDKVYTPLEFFGPMCKY  
YNYNGTGAYAAIYPNSDDIRTDVKYVHLEMVGEYGISVYTHETHVNDRAIYLGGFHREGTDAEAYAQ  
GMLQTPVTGSGFDEFGSLGINMVFKRKNDGNQWYITDPKTLKTREDINRYMKGYNDTLTLLDEIEAESV  
ISQQNKDLNSAWFKKIDREYRDNNKLNQWDKIRNLSQEEKNELNIQSVNDLVDQQLMTNRNPNNGIYKP  
EAI SYNDQSPYVGVRRMTGIYGGNTSKGAPGAVSFKHNAFRLWGYGYENGFLGYASNKYKQSKTDGE  
SVLSDEYIIKKISNNTFNTIEEFKKAYFKEVKDKATKGLTTFEVNGSSVSSYDDLTLFKEAVKKDAET  
LKQEANGNKTVSMNNTVKLKEAVYKLLQQTNSFKTSIFK

**SP126 nucleotide (SEQ ID NO:223)**

TAAGACAGATGAACGGAGCAAGGTGTTTGACTTTTCCATTCCCTACTATACTGCAAAAAATAAACTCAT  
TGTCAAAAATCTGACTTGACTACTTATCAGTCTGTAAACGACTTGGCGCAGAAAAAGGTTGGAGCGCA  
GAAAGGTTTCGATTCAAGAGACGATGGCGAAAGATTTGCTACAAAATCTTCCCTCGTATCTCTGCCTAA  
AAATGGGAATTTAATCAGATTTAAAATCAGGACAAGTGGATGCCGTTATCTTTGAAGAACCTGTTTC  
CAAGGGATTTGTGGAAAATAATCCTGATTTAGCAATCGCAGACCTCAATTTTGAAAAAGAGCAAGATGA  
TTCTACGCGGTAGCCATGAAAAAGATAGCAAGAAATTGAAGAGGCAGTTCGATAAAACCATTCAAAA  
GTTGAAGGAGTCTGGGGAATTAGACAAACTCATTGAGGAAGCCTTA

**SP126 amino acid (SEQ ID NO:224)**

KTDERSKVFDFSIYYTAKNKLIVKKSDLTTYQSVNDLAQKKVGAQKGSIQETMAKDLLQNSSLVSLPK  
NGNLITDLKSGQVDVIFEEPVSKEFVENNPDLAIADLNFEKEQDDSYAVAMKKDSKKLKRQFDKTIQK  
LKESGELDKLIEAL

**SP127 nucleotide (SEQ ID NO:225)**

CTGTGAGAATCAAGCTACACCCAAAGAGACTAGCGCTCAAAAAGACAATCGTCCTTGCTACAGCTGGCGA  
CGTGCCACCATTGACTACGAAGACAAGGGCAATCTGACAGGCTTTGATATCGAAGTTTTAAAGGCAGT  
AGATGAAAACTCAGCGACTACGAGATTCAATTCCAAAGAACCGCCTGGGAGAGCATCTTCCAGGACT  
TGATTCTGGTCACTATCAGGCTGCGGCCAATAACTTGAGTTACACAAAAGAGCGTGCTGAAAAATACCT  
TTACTCGCTTCCAATTTCCAACAATCCCTCGTCCTTGTCAGCAACAAGAAAAATCCTTTGACTTCTCT  
TGACCAGATCGCTGGTAAAACAACAAGAGGATACCGGAACCTTCTAACGCTCAATTCATCAATAACTG  
GAATCAGAAACACACTGATAATCCCGCTACAATTAATTTTCTGGTGAGGATATTGGTAAACGAATCCT  
AGACCTTGCTAACGGAGAGTTTGATTTCTAGTTTTTGACAAGGTATCCGTTCAAAGATTATCAAGGA  
CCGTGGTTTAGACCTCTCAGTCGTTGATTTACCTTCTGCAGATAGCCCCAGCAATTATATCATTTTCTC  
AAGCGACCAAAAAGAGTTTAAAGAGCAATTTGATAAAGCGCTCAAAGAACTCTATCAAGACGGAACCT  
TGAAAACTCAGCAATACCTATCTAGGTGGTTCTTACCTCCCAGATCAATCTCAGTTACAA

**SP127 amino acid (SEQ ID NO:226)**

CENQATPKETSAQKTIVLATAGDVPPFDYEDKGNLTGFDEVLKAVDEKLSDEYIQFORTAWESIFPGL  
DSGHYQAAANNLSYTKERAKEYLYSLPISNNPLVLVSNKKNPLTSLDQIAGKTTQEDTGTSNAQFINNW  
NQKHTDNPATINFSGEDIGKRILDLANGEFDLVFDKVSQKIIKDRGLDLSVVDLPSADSPSNYIIFS  
SDQKEFKEQFDKALKELYQDGTLEKLSNTYLGGSYLPDQSQLQ

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Table 2

*S. pneumoniae* Antigenic Epitopes**SP001**

Lys-1 to Ile-10; Leu-13 to Lys-32; Arg-41 to Ile-51; Ser-85 to Glu-97; Ala-159 to His-168; Val-309 to Thr-318; Val-341 to Asn-352; Asn-415 to Met-430; Phe-454 to Asn-464; Ser-573 to Gly-591; Asn-597 to Thr-641; and Asn-644 to Ala-664.

**SP004**

Thr-9 to Thr-24; Ile-29 to Ala-48; Thr-49 to Val-56; Val-286 to Val-312; Pro-316 to Glu-344; Val-345 to Ile-367; Gln-368 to Val-399; Ser-400 to Glu-431; Asn-436 to Ala-457; Ile-467 to Ala-498; and Thr-499 to Glu-540.

**SP006**

Glu-1 to Lys-13; Pro-24 to Gly-36; Val-104 to Thr-112; Ala-118 to Asn-130; Trp-137 to Ala-146; Ser-151 to Ile-159; Ile-181 to Leu-188; and Pro-194 to Tyr-202.

**SP007**

Gly-1 to Asn-7; Tyr-24 to Gln-34; His-47 to Phe-55; Ser-60 to Ala-67; Ala-122 to Leu-129; Leu-221 to Lys-230; Val-236 to Phe-256; and Asp-271 to Gly-283; and Leu-291 to Asp-297.

**SP008**

Leu-4 to Lys-17; Gln-24 to Leu-32; Asp-60 to Ser-66; Ser-70 to Asp-76; Ala-276 to Lys-283; Asn-304 to Lys-311; and Thr-429 to Pro-437.

**SP009**

Thr-4 to Glu-11; Leu-50 to Asp-60; Ile-102 to Trp-123; and Ser-138 to Ile-157.

**SP010**

Phe-34 to Gly-41; Asp-44 to Lys-50; Leu-172 to Val-186; Leu-191 to Val-198; Ser-202 to Ile-209; and Val-213 to Leu-221.

**SP011**

Asn-2 to Thr-10; Asp-87 to Ala-102; Tyr-125 to Glu-132; Thr-181 to Tyr-189; Arg-217 to Thr-232; Asn-257 to Lys-264; Pro-271 to Ser-278; Tyr-317 to Ala-325; Glu-327 to Pro-337; and Thr-374 to Val-381.

**SP012**

Gly-1 to Lys-19; Phe-34 to Tyr-41; Leu-109 to Lys-126; and Leu-231 to Glu-247.

**SP013**

Ala-1 to Lys-12; Ile-42 to Pro-53; Leu-138 to Lys-146; Ile-205 to Lys-217; Ser-235 to Ile-251; and Ser-261 to Tyr-272.

**SP014**

Gly-1 to Val-16; Leu-35 to Leu-44; Asp-73 to Asp-81; Ile-83 to Asp-92; Glu-145 to Ile-153; Phe-188 to Asn-196; Ser-208 to Phe-215; Ile-224 to Leu-231; and Asn-235 to Ala-243.

**SP015**

Ser-1 to Pro-16; Asn-78 to Glu-88; Ala-100 to Val-108; Ala-122 to Thr-129; Thr-131 to Ser-137; Leu-201 to Ser-220; and Gly-242 to Val-251.

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Table 2

*S. pneumoniae* Antigenic Epitopes**SP016**

Gly-1 to Glu-20; Thr-30 to Val-38; Gln-94 to Asn-105; Lys-173 to Pro-182; Gly-189 to Arg-197; Ser-207 to Val-224; Pro-288 to Leu-298; Ala-327 to Ala-342; and Ser-391 to Ala-402.

**SP017**

Ser-1 to Thr-12; Ala-36 to Tyr-45; Gln-48 to Ile-54; Lys-59 to Lys-76; Tyr-113 to Leu-138; and Phe-212 to Asp-219.

**SP019**

Val-97 to Glu-117; Asp-163 to Leu-169; Thr-182 to Thr-191; and Lys-241 to Ser-250.

**SP020**

Asn-18 to Lys-25; Thr-47 to Glu-60; Trp-75 to Val-84; Gly-102 to Val-110; Pro-122 to Ala-131; and Glu-250 to Pro-258.

**SP021**

Ser-1 to Asp-8; Val-44 to Asp-54; Ala-117 to Val-125; Thr-165 to Thr-173; and Glu-180 to Pro-189.

**SP022**

Phe-5 to Lys-13; Thr-20 to Ser-36; Glu-59 to Lys-81; Tyr-85 to Gly-93; Trp-94 to Trp-101; and Thr-195 to Trp-208.

**SP023**

Gln-45 to Glu-59; Asp-69 to Pro-85; Lys-111 to Asn-121; Pro-218 to Ala-228; and Glu-250 to Asn-281.

**SP025**

Gln-14 to Thr-20; Gly-27 to Phe-33; Gly-63 to Glu-71; and Ile-93 to Phe-102.

**SP028**

Asp-171 to Pro-179; Tyr-340 to Glu-350; Pro-455 to Tyr-463; and Asp-474 to Pro-480.

**SP030**

Leu-22 to Leu-37; Trp-81 to Ala-90; Phe-101 to Ala-106; Thr-124 to Tyr-130; and Asn-138 to Glu-144.

**SP031**

Asp-8 to Val-16; Gly-27 to Thr-35; Gly-178 to Asp-195; Thr-200 to Asp-209; Trp-218 to Leu-224; and Lys-226 to Asp-241.

**SP032**

Ser-9 to Asp-28; Phe-31 to Val-40; Gly-42 to Arg-50; Ile-52 to Leu-60; Asp-174 to Phe-186; Leu-324 to Met-333; and Thr-340 to Asn-347.

**SP033**

Gln-2 to Ile-13; Phe-46 to Ile-53; and Asp-104 to Thr-121.

**SP034**

Glu-36 to Gly-43; Ala-188 to Asp-196; Trp-313 to Gly-320; and Leu-323 to Leu-329.

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Table 2

*S. pneumoniae* Antigenic Epitopes**SP035**

Arg-19 to Asp-36; Asp-47 to Val-57; Asn-134 to Thr-143; Asp-187 to Arg-196; and Glu-222 to Ser-230.

**SP036**

Arg-10 to Arg-17; Lys-29 to Ser-39; Ser-140 to Ala-153; Arg-158 to Tyr-169; Asp-175 to Ala-183; Gly-216 to Asn-236; Ala-261 to Leu-270; Arg-282 to Phe-291; and Thr-297 to Ala-305; Pro-342 to Gln-362; Phe-455 to Asp-463; His-497 to Thr-511; Ala-521 to Gly-529; Ile-537 to Val-546; Ile-556 to Ala-568; Pro-581 to Ser-595; Glu-670 to Ala-685; Ser-696 to Ala-705 and Leu-782 to Ser-791.

**SP038**

Glu-61 to Pro-69; Phe-107 to Ala-115; Leu-130 to Tyr-141; Ala-229 to Glu-237; Ser-282 to Asn-287; Ala-330 to Glu-338; and Tyr-387 to Glu-393.

**SP039**

Ser-28 to Asp-35; Pro-88 to Pro-96; Leu-125 to Arg-135; Phe-149 to Leu-157; Gln-246 to Val-254; Ala-357 to Thr-362; Gly-402 to Lys-411; and Leu-440 to Pro-448.

**SP040**

Thr-21 to Ile-30; His-54 to Gln-68; Arg-103 to Leu-117; and Thr-127 to Leu-136.

**SP041**

Gly-36 to Asp-49; Leu-121 to Val-128; and Ala-186 to Ile-196.

**SP042**

Gly-11 to Arg-19; Ile-23 to Lys-31; His-145 to Asn-151; Gln-159 to Asp-166; Ile-175 to Asp-181; Gly-213 to Tyr-225; Ile-283 to Val-291; Pro-329 to Glu-364; Arg-372 to Ser-386; Thr-421 to Phe-430; Leu-445 to Val-453; Ile-486 to Ala-497; Asp-524 to Ala-535; His-662 to Gly-674; and His-679 to Gln-702.

**SP043**

Lys-2 to Asp-12; Val-58 to Asn-68; Ser-87 to Asp-95; and Asp-102 to Lys-117.

**SP044**

Gln-3 to Lys-11; Asp-37 to Tyr-52; Glu-171 to Leu-191; His-234 to Asn-247; and Asn-283 to Ala-291.

**SP045**

Tyr-52 to Ile-63; Asp-212 to Gln-227; Ser-315 to Thr-332; Leu-345 to Phe-354; Asp-362 to Val-370; Thr-518 to Asn-539; Ala-545 to Lys-559; and Val-601 to Pro-610.

**SP046**

Gln-9 to Ala-18; Glu-179 to Lys-186; Lys-264 to Glu-271; Gly-304 to Glu-17; Ser-503 to Asn-511; Asn-546 to Thr-553; and Asn-584 to Asp-591.

**SP048**

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Table 2

*S. pneumoniae* Antigenic Epitopes

Tyr-4 to Asp-25; Lys-33 to Val-70; Asp-151 to Thr-170; Asp-222 to Val-257; Thr-290 to Phe-301; and Gly-357 to Val-367.

**SP049**

Ala-23 to Arg-37; Tyr-85 to Gln-95; Glu-106 to Ile-118; Arg-131 to Ile-144; Gly-150 to Ser-162; and Ala-209 to Asp-218.

**SP050**

Asp-95 to Glu-113; Gly-220 to Gly-228; Asn-284 to Glu-295; Thr-298 to Val-315.

**SP051**

Lys-16 to Glu-50; Lys-57 to Asn-104; Ser-158 to Trp-173; Asp-265 to Pro-279; Val-368 to Tyr-386; Glu-420 to Ile-454; Pro-476 to Ile-516; Phe-561 to Gly-581; Thr-606 to Gly-664; and Glu-676 to Val-696.

**SP052**

Asn-41 to Tyr-60; Phe-80 to Glu-103; Ala-117 to Val-139; Ile-142 to Leu-155; Val-190 to Lys-212; Glu-276 to Phe-283; Arg-290 to Ser-299; Leu-328 to Val-351; Gly-358 to Thr-388; Glu-472 to Ala-483; Val-533 to Asn-561; Asp-595 to Val-606; Glu-609 to Val-620; Glu-672 to Ser-691.

**SP053**

Ala-62 to Val-101; Thr-147 to Leu-174; Lys-204 to Val-216; Gln-228 to Val-262; Ser-277 to Gly-297; Thr-341 to Gly-368; Thr-385 to Ala-409; Thr-414 to Ser-453; Asn-461 to Leu-490; Glu-576 to Thr-625; Gly-630 to Arg-639; and Asp-720 to Leu-740.

**SP054**

Glu-7 to Val-28; and Tyr-33 to Glu-44.

**SP055**

Pro-3 to Val-18; Thr-21 to Lys-53; Val-84 to Lys-99; Ile-162 to Val-172; and Val-204 to Ser-241.

**SP056**

Val-34 to Tyr-41; Leu-47 to Glu-55; and Pro-57 to Gln-66.

**SP057**

Asp-1 to Val-25; Pro-29 to Ile-80; Asn-96 to Val-145; and Pro-150 to Glu-172.

**SP058**

Ala-64 to Thr-70; Leu-82 to His-138; and Val-228 to Asn-236.

**SP059**

Val-10 to Thr-24; Ser-76 to Pro-102; Ser-109 to Ile-119; Ser-124 to Val-130; Thr-186 to Ile-194; and Asn-234 to Ser-243.

**SP060**

Leu-70 to Arg-76; and Val-79 to Ile-88.

**SP062**

Glu-14 to Lys-28; Ser-32 to Lys-46; and Glu-66 to Thr-74.

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Table 2

*S. pneumoniae* Antigenic Epitopes**SP063**

Ile-10 to Val-25; Val-30 to Thr-40; Asp-44 to Pro-54; Asn-57 to Val-63; Pro-71 to Val-100; and Thr-105 to Thr-116.

**SP064**

Pro-12 to Leu-32; Val-40 to Leu-68; Asp-95 to Ala-125; Ser-164 to Glu-184; Ser-314 to Glu-346; Asn-382 to Val-393; Leu-463 to Gln-498; Asn-534 to Lys-548; and Lys-557 to Gly-605.

**SP065**

Asn-2 to Ile-12; Ala-39 to Thr-61; and His-135 to Ala-155.

**SP067**

Gly-1 to Thr-13; Asp-203 to Asn-218; and Gly-240 to Asp-253.

**SP068**

Ser-2 to Ser-12; Val-17 to Gln-26; and Lys-54 to Cys-67.

**SP069**

Ser-32 to Thr-41; Pro-66 to Glu-80; Thr-110 to Val-122; and Val-147 to Thr-180.

**SP070**

Lys-6 to Tyr-16; Gln-19 to Ile-27; Arg-50 to Ala-58; Leu-112 to Val-128; Ile-151 to Asn-167; Leu-305 to Phe-321.

**SP071**

Gln-92 to Asn-158; Gln-171 to Gln-188; Val-204 to Val-240; Thr-247 to Ala-273; Glu-279 to Thr-338; Pro-345 to Glu-368; Asn-483 to Lys-539; Val-552 to Ala-568; Glu-575 to Ser-591; Ser-621 to Gly-640; Gln-742 to Gly-758.

**SP072**

Val-68 to Tyr-81; Tyr-86 to Val-121; Leu-127 to Gly-140; Gly-144 to Ala-155; Gln-168 to Val-185; Asp-210 to Tyr-241; Glu-246 to Thr-269; Lys-275 to Tyr-295; Gly-303 to Pro-320; Arg-327 to Ile-335; Thr-338 to Thr-364; Tyr-478 to Phe-495; and Tyr-499 to Arg-521.

**SP073**

Glu-37 to Val-45; Glu-55 to Val-68; Thr-104 to Thr-119; Ile-127 to Tyr-135; Asn-220 to Ile-232; Thr-237 to Ala-250; Ser-253 to Ala-263; Glu-284 to Ile-297; and Met-438 to Asn-455.

**SP074**

Gly-2 to Ala-12; Gly-96 to Ile-110; and Thr-220 to Phe-239.

**SP075**

Phe-33 to Tyr-42; Gln-93 to Gly-102; and Val-196 to Asp-211.

**SP076**

Ser-64 to Leu-76; and Phe-81 to Ala-101.

**SP077**

Asp-1 to Glu-12; Tyr-26 to Val-36; and Val-51 to Tyr-62.

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Table 2

*S. pneumoniae* Antigenic Epitopes**SP078**

Ala-193 to Ile-208; Tyr-266 to Asn-275; Glu-356 to Leu-369; Ala-411 to Gly-422; Ser-437 to Pro-464; Thr-492 to Glu-534; and Glu-571 to Gln-508.

**SP079**

Gly-11 to Leu-20; Lys-39 to Leu-48; Leu-72 to Val-85; Asn-147 to Ser-158; Ile-178 to Asp-187; Tyr-189 to Gln-201; and Leu-203 to Ala-216

**SP080**

Ser-2 to Glu-12; Gln-42 to Ala-51; Ala-116 to Ser-127; Phe-131 to Asp-143; and Ile-159 to Ile-171.

**SP081**

Gln-2 to Leu-9; Gln-49 to Cys-57; Ile-108 to Val-131; Gly-134 to Leu-145; and Trp-154 to Cys-162.

**SP082**

Ile-101 to Ser-187; Gly-191 to Asn-221; Arg-225 to Arg-236; Tyr-239 to Leu-255; and Gly-259 to Arg-268.

**SP083**

Ser-28 to Asp-70.

**SP084**

Leu-42 to Gln-66; Thr-69 to Lys-81; Glu-83 to Arg-92; and Gly-98 to Asn-110.

**SP085**

Gln-2 to Val-22; and Ser-45 to Glu-51.

**SP086**

Leu-18 to Gln-65; and Lys-72 to Val-83.

**SP087**

Ser-45 to Leu-53; and Thr-55 to Gln-63

**SP088**

Pro-8 to Ile-16; Leu-25 to Trp-33; Tyr-35 to Gln-43; Leu-51 to Val-59; Val-59 to Arg-67; Thr-55 to Tyr-63; Asn-85 to Gly-93; Thr-107 to Leu-115; Leu-115 to Trp-123; Ala-121 to Thr-129; Tyr-153 to Ala-161; His-176 to Gly-184; Tyr-194 to Ala-202; Ala-217 to Gly-225; and Asn-85 to Gly-93.

**SP089**

Trp-43 to Ala-51; Gln-68 to Phe-76; Val-93 to Gln-101; Phe-106 to Phe-114; Lys-117 to Lys-125; Trp-148 to Phe-156; Glu-168 to Gln-176; Ile-193 to Tyr-201; Lys-203 to Lys-211; Glu-212 to Gln-220; Ile-237 to Tyr-245; Lys-247 to Lys-255; Glu-256 to Gln-264; Met-275 to Gly-283; Lys-286 to Gly-294; Trp-292 to Glu-300; Asp-289 to Thr-297; Tyr-315 to Ser-323; Asp-334 to Lys-342; Pro-371 to Arg-379; Arg-485 to Asn-493; Lys-527 to Arg-535; Phe-537 to Met-545; and Tyr-549 to Glu-557.

**SP090**

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Table 2

*S. pneumoniae* Antigenic Epitopes

Phe-2 to Gln-10; Gln-13 to Lys-21; Tyr-19 to Glu-27; Tyr-39 to Met-47; Pro-65 to Leu-73; Tyr-121 to His-129; Lys-147 to Ile-155; Gly-161 to Lys-169; Gly-218 to Trp-226; Asp-230 to Thr-238; Tyr-249 to Ala-257; and Ala-272 to Gly-280.

**SP091**

Ser-19 to Ser-27; Asn-25 to Thr-33; Val-51 to Gln-59; Asn-75 to Asn-83; Ile-103 to Trp-111; Tyr-113 to Ala-121; Leu-175 to Asn-183; Glu-185 to Trp-193; Ala-203 to Tyr-211; Val-250 to Phe-258; Asn-260 to Thr-268; Ser-278 to Asp-286; Tyr-305 to Leu-313; Asn-316 to Gly-324; Asn-374 to Asp-382; Asn-441 to Gly-449; and Ser-454 to Gln-462.

**SP092**

Arg-95 to Glu-103; Ala-216 to Val-224; Leu-338 to Glu-346; Pro-350 to Ala-358; Pro-359 to Ala-367; Pro-368 to Ala-376; Pro-377 to Ala-385; Pro-386 to Ala-394; Pro-395 to Ala-403; Pro-350 to Ala-358; Gln-414 to Lys-422; Pro-421 to Asn-429; Trp-465 to Tyr-473; Phe-487 to Tyr-495; Asn-517 to Gly-525; Trp-586 to Tyr-594; Phe-608 to Tyr-616; and Asp-630 to Gly-638.

**SP093**

Gln-30 to Ile-38; Gln-52 to Val-60; Ala-108 to His-116; Tyr-133 to Glu-141; Tyr-192 to Ala-200; and Phe-207 to Ser-215.

**SP094**

Ala-87 to Val-95; Leu-110 to Cys-118; Gln-133 to Leu-141; Ser-185 to Leu-193; Ile-195 to Gly-203; Asp-206 to Gln-214; Ser-211 to Gly-219; Ile-241 to Thr-249.

**SP095**

Arg-1 to Gln-9; Phe-7 to Asn-15; Thr-21 to Asn-30; Leu-46 to Phe-54; and Ser-72 to Met-80.

**SP096**

Gly-29 to Ile-37; Glu-52 to Ser-60; and Leu-64 to Gly-72.

**SP097**

Ala-11 to Thr-19; Glu-53 to Glu-61; Ser-91 to Lys-99; Thr-123 to Gln-131; and Gly-209 to Lys-217.

**SP098**

Thr-3 to Ser-11; Gly-38 to Phe-46; Tyr-175 to Asn-183; Met-187 to Cys-195; Gln-197 to Leu-205; Tyr-307 to Gln-315; Gly-318 to Tyr-326; Asn-348 to Val-356; Lys-377 to Pro-385; and Leu-415 to Val-423.

**SP099**

Arg-19 to Gly-27; Asp-76 to Ser-84; Val-90 to Lys-98; Phe-165 to Val-173; Leu-237 to Pro-245.

**SP100**

His-111 to Gln-119; Ser-141 to His-149; Asp-154 to Ser-162; Gln-158 to Gln-166; Asp-154 to Gln-166; Lys-180 to Gln-188; and Ser-206 to Gln-214.

**SP101**

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Table 2

*S. pneumoniae* Antigenic Epitopes

Glu-23 to Glu-31; Glu-40 to Val-48; Gln-50 to Ser-58; Thr-61 to Ile-69; Leu-82 to Ile-90; Ala-108 to Leu-116; Gln-121 to Pro-129; and Leu-130 to Thr-138.

**SP102**

Asp-32 to His-40; Arg-48 to Lys-56; and Asp-102 to Thr-110.

**SP103**

Arg-5 to Gln-13; Gln-22 to Leu-30; Arg-151 to Gln-159; Arg-167 to Gln-175; Pro-189 to Glu-197; Gly-207 to Leu-215; Ser-219 to Gln-227; Ser-233 to Ser-241; Pro-255 to Asp-264; Lys-272 to Gly-280; Ser-318 to Val-326; Thr-341 to Asp-351; Asn-356 to Thr-364; Val-370 to Tyr-378; Ile-379 to Gln-387; and Met-435 to Tyr-443.

**SP105**

Asn-28 to Pro-36; Thr-77 to Phe-85; Arg-88 to Val-96; Gly-107 to Phe-115; Asp-169 to Asp-177; His-248 to Ser-256; and Ser-274 to Ala-282.

**SP106**

Val-10 to Thr-18; Ile-62 to Tyr-70; Ile-71 to Pro-79; Lys-86 to Gln-94; Lys-100 to Thr-108; Phe-132 to Leu-140; and Asp-145 to Arg-153.

**SP107**

Asp-33 to Val-41; and Arg-63 to Gln-71.

**SP108**

Lys-9 to Gln-17; Leu-44 to Ser-52; Ser-63 to Phe-71; Tyr-109 to Ser-117; Ile-183 to Ile-191; Pro-194 to Leu-202; Gly-257 to Gln-265; Ala-323 to Thr-331; and Leu-381 to Tyr-389.

**SP109**

Asn-2 to Gln-10; Ala-65 to Lys-73; Leu-76 to Glu-84; Thr-111 to Asp-119; Gln-116 to Tyr-124; Tyr-130 to Val-138; Asp-173 to Gly-181; Asp-196 to Ser-204; Asn-231 to Ser-239; Phe-252 to Ser-260; Phe-270 to Tyr-278; Val-291 to His-299; Asp-306 to Leu-314; and Pro-327 to Gly-335.

**SP110**

Ser-8 to Glu-16; Ile-37 to Val-45; Ala-107 to Val-115; and Gly-122 to Thr-130.

**SP111**

Asp-19 to Glu-28; Leu-43 to Ala-51; Asn-102 to Phe-110; Gln-133 to Ser-141; Phe-162 to Asp-170; Tyr-194 to Met-202; and Asp-273 to Ser-281.

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Table 2

*S. pneumoniae* Antigenic Epitopes**SP112**

Asp-3 to Gln-11; Gly-21 to Ile-29; Ala-46 to Arg-54; Arg-98 to Arg-106; Thr-114 to Val-122; Gln-133 to Asn-141; and Leu-223 to Thr-231.

**SP113**

Asn-19 to Gly-27; Arg-54 to Ser-62; Val-69 to Gln-77; Ser-117 to Asn-125; Gly-164 to Leu-172; Tyr-193 to Ser-201; Cys-303 to Phe-311; His-315 to Ile-323; Arg-341 to Cys-349; Ile-347 to Ser-355; Arg-403 to Phe-411; Gln-484 to Pro-492; Ser-499 to Leu-507; Ile-541 to Thr-549  
Asn-622 to Ile-630; and Glu-645 to Gly-653.

**SP114**

Gly-17 to Leu-25; His-40 to Gln-48; Arg-49 to Arg-57; Ile-65 to Pro-73;  
Asn-101 to Asp-111; Gly-128 to Cys-136; Phe-183 to Thr-191; and Pro-268 to Ile-276.

**SP115**

Met-8 to Ser-16; Tyr-24 to Leu-32; Cys-68 to Leu-76; Ser-100 to Pro-108; Thr-193 to Thr-201; Gly-238 to Pro-250; Thr-280 to Phe-288; Pro-303 to Asn-312; Trp-319 to Leu-328; Leu-335 to Leu-344; Lys-395 to Ala-403; Asn-416 to Gln-424; Tyr-430 to Ser-438; Val-448 to Leu-456; Leu-460 to Thr-468; Pro-502 to Thr-510; Lys-515 to Ile-524; Gln-523 to His-532; Tyr-535 to Thr-543; Ser-559 to Pro-567; Thr-572 to Asn-580;  
Val-594 to Arg-602; Arg-603 to Asn-611; Thr-620 to Trp-628; and Tyr-644 to Arg-653.

**SP117**

Ala-6 to Gly-14; Ile-19 to Thr-27; Thr-99 to Leu-107; Ser-117 to Asp-125; His-131 to Val-139; Ile-193 to Gly-201; and Val-241 to Gln-249.

**SP118**

Ser-8 to Trp-23; His-46 to Ala-54; Asn-93 to Gly-101; Val-100 to Ser-108; Arg-155 to Asp-163; and His-192 to Leu-200.

**SP119**

Tyr-46 to Lys-54; Ser-93 to Ser-101; Trp-108 to Asn-116; Val-121 to Glu-129; and Tyr-131 to Gln-139.

**SP120**

Ala-57 to Lys-65; Leu-68 to Glu-76; Thr-103 to Tyr-116; Tyr-122 to Val-130; His-163 to Gly-173; Asp-188 to Ser-196; Ser-222 to Ser-231; Phe-244 to Ser-252; Pro-262 to Tyr-270; Val-283 to His-291; and Asp-298 to Leu-306.

**SP121**

Ser-3 to Ala-11; Asp-13 to Leu-21; Ser-36 to Val-44; and Gln-136 to Met-144.

**SP122**

Asn-28 to Lys-36; Glu-39 to Thr-50; Val-54 to Lys-62; Asn-106 to Leu-114; Phe-159 to Gly-167; Asn-172 to Arg-180; Glu-199 to Asn-207;

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Table 2

*S. pneumoniae* Antigenic Epitopes

Lys-230 to His-241; Asn-252 to Gly-263; Met-278 to Ala-287; Thr-346 to Asp-354; Lys-362 to Thr-370; Asp-392 to Asn-405; Asp-411 to Ala-424; Gly-434 to Gly-443; Tyr-484 to Glu-492; Ile-511 to Leu-519; Asn-524 to Asp-538; Glu-552 to Ile-567; Val-605 to Lys-613; Phe-697 to Ala-705; Phe-722 to Leu-730; Leu-753 to Leu-761; Asp-787 to Gln-795; Leu-858 to Asn-866; Ala-892 to Thr-901; Gly-903 to Ile-913; Ile-921 to Asn-931; Asn-938 to Pro-951; Gly-960 to Lys-970; Leu-977 to Asp-985; and Leu-988 to Pro-996.

**SP123**

Val-4 to Asn-12; Glu-47 to Leu-55; Lys-89 to Glu-100; Ser-165 to Thr-173; Lys-234 to Val-242; Ser-258 to Ser-266; Glu-284 to Asn-292; Tyr-327 to Leu-335; Tyr-457 to Thr-465; Tyr-493 to Glu-501; Thr-506 to Tyr-514; Lys-517 to Thr-525; Asn-532 to Gly-540; and Arg-556 to Glu-564.

**SP124**

Arg-16 to Glu-24; Gln-52 to Arg-60; Asn-69 to Tyr-77; Glu-121 to Asn-129; Ala-134 to Val-142; Thr-151 to Ala-159; Asn-164 to Glu-172; His-181 to His-189; Thr-210 to Ala-218; Ser-244 to Val-252; Phe-287 to Tyr-297; Ser-312 to Thr-323; His-433 to Tyr-441; Ser-445 to Asn-453; Asn-469 to Thr-477; Asn-501 to Asn-509; Gln-536 to Ala-547; and Gln-608 to Asp-621.

**SP125**

Ser-9 to Asp-21; Ala-28 to Leu-36; Asn-49 to Phe-57; Val-137 to Arg-145; Asn-155 to Leu-163; Glu-183 to Asp-191; Gly-202 to Tyr-210; Pro-221 to Asp-229; Phe-263 to Ala-271; Phe-300 to Gln-308; Asp-313 to Glu-321; Asn-324 to Asp-332; Ile-346 to Asn-354; Asp-362 to Lys-370; Met-402 to Gly-410; Gly-437 to Gly-445; Ser-471 to Glu-483; Gly-529 to Asp-537; Gln-555 to Val-563; and Leu-579 to Lys-587.

**SP126**

Leu-22 to Thr-30; Val-65 to Leu-73; and Thr-75 to Asp-83.

**SP127**

Glu-2 to Ala-12; Asp-28 to Thr-36; Val-105 to Thr-113; Lys-121 to Thr-129; Trp-138 to Pro-146; Ser-152 to Ile-160; Lys-180 to Asp-188; Leu-194 to Asn-202; and Gly-228 to Thr-236.

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Table 3

Primer		<i>S. pneumoniae</i> ORF Cloning Primers	
Name	SEQ ID	Sequence	RE
SP001A	NO:227	GACTGGATCCTAAAATCTACGACAATAAAAATC	Bam HI
SP001B	NO:228	CTGAGTCGACTGGTTGTGCTGGTTGAG	Sal I
SP004A	NO:229	GTCAGGATCCAAATTACAATACGGACTATG	Bam HI
SP004B	NO:230	CAGTGTGACTAACTCTAGGTCGGAAAC	Sal I
SP006A	NO:231	GACTGGATCCTGAGAATCAAGCTACACCCAAAGAG	Bam HI
SP006B	NO:232	AGTCAAGCTTTTGTAACTGAGATTGATCTGG	Hind III
SP007A	NO:233	GACTGGATCCTGGTAACCGCTCTTCTCGTAACGCAGC	Bam HI
SP007B	NO:234	AGTCAAGCTTTTTTCAGGAACTTTTACGCTTCC	Hind III
SP008A	NO:235	AGTCAGATCTTGTGGAAATTTGACAGGTAACAGCAAAAAAGCTGC	Bgl II
SP008B	NO:236	ACTGAAGCTTTTTTGTTTTTTCAAGAATTCATCG	Hind III
SP009A	NO:237	GACTGGATCCTGGTCAAGGAAGCTTCTTAAAGAC	Bam HI
SP009B	NO:238	AGTCAAGCTTTCACAAATTCGTTGGTGAAGCC	Hind III
SP010A	NO:239	GACTGGATCCTAGCTCAGGTGGAACGCTGGTTCATCC	Bam HI
SP010B	NO:240	AGTCAAGCTTATCAACTTTTCCACCTTCAACAACC	Hind III
SP011A	NO:241	GTCAAGATCTCTCCAACATATGGTAAATCTGCGGATGG	Bgl II
SP011B	NO:242	AGTCCTGCAGATCCACATCCGCTTTCATCGGGTTAAAGAAGG	Pst I
SP012A	NO:243	GACTGGATCCTGGGAAAAATCTAGCGAAACTAGTGG	Bam HI
SP012B	NO:244	GTCAGTGCAGCTGTCCTTCTTTTACTTCTTTGGTTGC	Pst I
SP013A	NO:245	GACTGGATCCTGCTAGCGGAAAAAAGATACAACCTTCTGG	Bam HI
SP013B	NO:246	CTGAAAGCTTTTTTGCCAAATCCTTCAGCAATCTTGTC	Hind III
SP014A	NO:247	GACTAGATCTTGGCTCAAAAAATACAGCTTCAAGTCC	Bgl II
SP014B	NO:248	AGTCCTGCAGGTTTTTGTGTTGGTATTGGTCG	Pst I
SP015A	NO:249	GACTGGATCCTAGTACAAACTCAAGCACTAGTCAGACAGAG	Bam HI
SP015B	NO:250	CAGTCTGCAGTTTCAAAGCTTTTTGTATGTCTTC	Pst I
SP016A	NO:251	GACTGGATCCTGGCAATTCTGGCGGAAGTAAAGATGC	Bam HI
SP016B	NO:252	AGTCAAGCTTGTTCATAGCTTTTTTGTATTGTTTCG	Hind III
SP017A	NO:253	GACTGGATCCTTCACAAGAAAAACAAAAATGAAGATGG	Bam HI
SP017B	NO:254	AGTCAAGCTTATCGACGTAGTCTCCGCCTTC	Hind III
SP019A	NO:255	GACTGGATCCGAAAGGTCTGTGGTCAAATAATCTTACC	Bam HI
SP019B	NO:256	AGTCAAGCTTAGAGTTAATCATGGTGCTTGCCAATAGG	Hind III
SP020A	NO:257	GACTGGATCCAAACTCAGAAAAGAAAGCAGACAATGC	Bam HI
SP020B	NO:258	AGTCAAGCTTCCAAACTGGTTGATCCAAACCATCTG	Hind III
SP021A	NO:259	GACTGGATCCTTCGAAAGGGTCAGAAGGTGCAGACC	Bam HI
SP021B	NO:260	AGTCAAGCTTCTGTAGGCTTGGTGTGCCCCAGTTGC	Hind III
SP022A	NO:261	CTGAGGATCCGGGGATGGCAGCTTTTAAAAATC	Bam HI
SP022B	NO:262	CAGTAAGCTTGTTTACCCATTACCATTTACC	Hind III
SP023A	NO:263	CAGTGGATCCAGACGAGCAAAAAATTAAG	Bam HI
SP023B	NO:264	TCAGAAGCTTGTTTACCCATTACCATTT	Hind III
SP025A	NO:265	GACTGGATCCCTGTGGTGAGGAAGAACTAAAAAG	Bam HI
SP025B	NO:266	CTGAGTCGACAATATTCTGTAGGAATGCTTCGAATTTG	Sal I
SP028A	NO:267	CTGAGGATCCGACTTTTAAACAATAAACTATTGAAGAG	Bam HI
SP028B	NO:268	GTCAGTGCAGGTTGTACCTCCAAAAATCACGG	Pst I
SP030A	NO:269	GACTGGATCCCCTTTACAGGTAAACAACATAAGTCGG	Bam HI
SP030B	NO:270	CAGTAAGCTTTTCGAAGTTTGGCTCAGAATTG	Hind III
SP031A	NO:271	GACTGGATCCCCAGGCTGATACAAGTATCGCA	Bam HI
SP031B	NO:272	CAGTAAGCTTATCTGCAGTATGGCTAGATGG	Hind III
SP032A	NO:273	GACTGGATCCGCTCTGTATCATTTGAAAACAAAGAAAC	Bam HI
SP032B	NO:274	CAGTCTGCAGTTTTACTGTTGCTGTGCTTGTG	Pst I
SP033A	NO:275	ACTGAGATCTTGGTCAAAGGAAAGTCAGACAGGAAAGG	Bgl II
SP033B	NO:276	CAGTAAGCTTATTCCTGAGCTTTTTTGATAAAGGTTGCGCA	Hind III
SP034A	NO:277	ACTGGGATCCGAAGGATAGATATATTTTAGCATTTGAGAC	Bam HI
SP034B	NO:278	AGTCAAGCTTCCATGGTATCAAAGGCAAGACTTGG	Hind III
SP035A	NO:279	GTCAGGATCCGGTAGTTAAAGTTGGTATTAACGG	Bam HI
SP035B	NO:280	AGTCAAGCTTGCAATTTTTGCGAAGTATTCGAAGAG	Hind III
SP036A	NO:281	AGTCGGATCCTTCTTACGAGTTGGGACTGTATCAAGC	Bam HI

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Table 3

Primer		<i>S. pneumoniae</i> ORF Cloning Primers		RE
Name	SEQ ID	Sequence		
SP036B	NO:282	AGTCAAGCTTGTTTATTTTTCCTTACTTACAGATGAAGG		Hind III
SP038A	NO:283	AGTCGGATCCTACTGAGATGCATCATAATCTAGGAGC		Bam HI
SP038B	NO:284	TCAGCTCGAGTTCTTTGACATCTCCATCATAAGTCGC		Xho I
SP039A	NO:285	GACTGGATCCGGTTTTTGAGAAAGTATTGTCAGGGG		Bam HI
SP039B	NO:286	CAGTAAGCTTGGATTTTTTCATGGATGCAATTTTTTTGG		Hind III
SP040A	NO:287	GACTGGATCCGACAACATTTACTATCCATACAGTAGAGTCAGC		Bam HI
SP040B	NO:288	GACTAAGCTTGGCATAAGGTTGCAATTCTGGATTAATTGG		Hind III
SP041A	NO:289	GACTGGATCCGGCTAAGGAAAGAGTGGATG		Bam HI
SP041B	NO:290	GACTAAGCTTTTCATTTTTTAAATTGACTATGCGCCCG		Hind III
SP042A	NO:291	GACTGGATCCTTGTTTCCTATGAAGTTGGTCGTCACC		Bam HI
SP042B	NO:292	CATGAAGCTTATCCTGGATTTTTCCAAGTAAATCT		Hind III
SP043A	NO:293	GACTGGATCCTTATAAGGGTGAATTAGAAAAAGG		Bam HI
SP043B	NO:294	GACTAAGCTTCTTATTAGGATTGTTAGTAGTTG		Hind III
SP044A	NO:295	GACTGGATCCGAATGTTTCAGGCTCAAGAAAGTTCAGG		Bam HI
SP044B	NO:296	GACTAAGCTTTTCCCCTGATGGAGCAAAGTAATACC		Hind III
SP045A	NO:297	GACTGGATCCCTTGGGTGTAACCCATATCCAGCTCCTTCC		Bam HI
SP045B	NO:298	GACTGTCGACTTCAGCTTGTTTATCTGGGGTTGC		Sal I
SP046A	NO:299	GACTGGATCCTAGTGATGGTACTTGGCAAGGAAAACAG		Bam HI
SP046B	NO:300	ACTGCTGCAGATCTTTGCCACCTAGCTTCTCATTG		Pst I
SP048A	NO:301	GTCAGGATCCTGGGATTCAATATGTCAGAGATGATACTAG		Bam HI
SP048B	NO:302	CTAGAAGCTTACGCACCCATTACCAATTATCATTG		Hind III
SP049A	NO:303	GTCAGGATCCGGATAAATAGAGAAGCATTAAAAACC		Bam HI
SP049B	NO:304	AGTCAAGCTTGACAAAATTGAAACTCCTCTGGTC		Hind III
SP050A	NO:305	GTCAGGATCCAGATTTTGTGCGAGGAGTGCATACC		Bam HI
SP050B	NO:306	AGTCAAGCTTTCCCTTTTTACCCCTTACGAATCCAGG		Hind III
SP051A	NO:307	GACTGGATCCATCTGTAGTTTATGCGGATGAAACACTTATTAC		Bam HI
SP051B	NO:308	GACTGTCGACGCTTTGGTAGAGATAGAAGTCATG		Sal I
SP052A	NO:309	GACTGGATCCTTACTTTGGTATCGTAGATACAGCCGGC		Bam HI
SP052B	NO:310	AGTCAAGCTTTGTAAATTGCGTACCTTCTAAGCGACC		Hind III
SP053A	NO:311	GACTGGATCCAGCTAAGGTTGCATGGGATGCGATTCC		Bam HI
SP053B	NO:312	GACTGTCGACCTGGGCTTTATTAGTTTGACTAGC		Sal I
SP054A	NO:313	CAGTGGATCCCTATCACTATGTAAATAAAGAGA		Bam HI
SP054B	NO:314	ACTGAAGCTTTTCTGTCCCTGTTTGAGGCA		Hind III
SP055A	NO:315	CAGTGGATCCTGAGACTCCTCAATCAATAACAAA		Bam HI
SP055B	NO:316	ACGTAAGCTTATAATCAGTAGGAGAACTGAACT		Hind III
SP056A	NO:317	CAGTGGATCCGGATGCTCAAGAACTGCGG		Bam HI
SP056B	NO:318	GACTAAGCTTTTGCCTCTCATTCTTGCTTCC		Hind III
SP057A	NO:319	CAGTGGATCCCGACAAAGGTGAGACTGAG		Bam HI
SP057B	NO:320	ACGTAAGCTTATTCTTAATTCAAGTGTTTTCTCTG		Hind III
SP058A	NO:321	GACTGGATCCAAATCAATTGGTAGACACAAGATCC		Bam HI
SP058B	NO:322	CAGTGTGACATTAGGAGCCACTGGTCTC		Sal I
SP059A	NO:323	CAGTGGATCCCAAACAGTCAGCTTCAGGAAC		Bam HI
SP059B	NO:324	GACTCTGCAGTTAATCTTGTTCCAGGTGG		Pst I
SP060A	NO:325	GACTGGATCCATTTCGATGATGCGGATGAAAAG		Bam HI
SP060B	NO:326	GACTAAGCTTCATTTGTCTTTGGGTATTTTCGCA		Hind III
SP062A	NO:327	CAGTGGATCCGGAGAGTCGATCAAAAGTAG		Bam HI
SP062B	NO:328	GTCAGTGCAGTTGCTCGTCTCGAGGTTT		Pst I
SP063A	NO:329	CAGTGGATCCATGGACAACAGGAACTGGGAC		Bam HI
SP063B	NO:330	CAGTAAGCTTATTAGCTTCTGTACCTGTGTTTG		Hind III
SP064A	NO:331	GACTGGATCCCGATGGGCTCAATCCAACCCAGGTCAAGTC		Bam HI
SP064B	NO:332	GACTCTGCAGCATAGCTTTATCCTCTGACATCATCGTATC		Pst I
SP065A	NO:333	GACTGGATCCTTCCAATCAAAAACAGGCAGATGG		Bam HI
SP065B	NO:334	GACTAAGCTTGAGTCCCATAGTCCAAGGCA		Hind III
SP067A	NO:335	AGTCGGATCCTATCACAGGATCGAACGGTAAGACAACC		Bam HI
SP067B	NO:336	ACTGGTCGACTTCTTTTAACTCCGCTACTGTGTC		Sal I

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Table 3

Primer		<i>S. pneumoniae</i> ORF Cloning Primers		RE
Name	SEQ ID	Sequence		
SP068A	NO:337	CAGTGGATCCAAGTTCATCGAAGATGGTTGGGAAGTCC		Bam HI
SP068B	NO:338	GATCGTCGACCCGCTCCACATGCTCAACCTT		Sal I
SP069A	NO:339	TGACGGATCCATCGCTAGCTAGTGAAATGCAAGAAAG		Bam HI
SP069B	NO:340	TGACAAGCTTATTCGTTTTTGAAGTAGTTGCTTTCGT		Hind III
SP070A	NO:341	GACTGGATCCGCACCAGATGGGGCACAAGGTTCAAGG		Bam HI
SP070B	NO:342	TGACAAGCTTAACTTGTAAACGAACAGTTCAATCTG		Hind III
SP071A	NO:343	GACTAGATCTTTTAAACCAACTGTTGGTACTTTCC		Bgl II
SP071B	NO:344	TGACAAGCTTGTAGGTGTTACATTTTGACCGTC		Hind III
SP072A	NO:345	ACTGAGATCTTTTAAACCAACTGTTGGTACTTTC		Bgl II
SP072B	NO:346	GACTAAGCTTTCTACGATAACGATCATTTTCTTTACC		Hind III
SP073A	NO:347	GACTGTCGACTCGTAGATATTTAAGTCTAAGTGAAGCG		Sal I
SP073B	NO:348	AGTCAAGCTTGTAGGTGTTACATTTTGCAAGTC		Hind III
SP074A	NO:349	GACTGGATCCCTTTGGTTTTGAAGGAAGTAAG		Bam HI
SP074B	NO:350	TGACCTGCAGACGATTTTTGAAAATGGAGGTGTATC		Pst I
SP075A	NO:351	CAGTGGATCCCTACTACCTCTCGAGAGAAAG		Bam HI
SP075B	NO:352	ACTGAAGCTTTTCGCTTTTTACTCGTTTGACA		Hind III
SP076A	NO:353	CAGTGGATCCTAAGGTCAAAGTCAGACCGCTAAGAAAGTGC		Bam HI
SP076B	NO:354	CAGTAAGCTTTAGGGTATCCAAATACTGGTTGTTGATG		Hind III
SP077A	NO:355	TGACAGATCTTGACGGGTCTCAGGATCAGACTCAGG		Bgl II
SP077B	NO:356	TGACAAGCTTCAAAGACATCCACCTCTTGACCTTTG		Hind III
SP078A	NO:357	GACTGGATCCTAGAGGCTTTGCCAAATGGTGGGAAGGG		Bam HI
SP078B	NO:358	GTCAGTCGACTTGTGTAAACACTTTTCGAGGTTTGGTACC		Sal I
SP079A	NO:359	CAGTGGATCCTCAAAAAGAGAAGGAAAACCTGG		Bam HI
SP079B	NO:360	CAGCTGCAGTTTCTTCAACAACCTTGTCTTG		Pst I
SP080A	NO:361	CAGTGGATCCACGTTCTATTGAGGACCACTT		Bam HI
SP080B	NO:362	CAGTAAGCTTTTCCTTCTCAGTCAATTCTTTTCC		Hind III
SP081A	NO:363	GACTGGATCCCGCTCAAATAACAGAGGTGTTTACG		Bam HI
SP081B	NO:364	GACTAAGCTTAGTACCATGGGTGTGACAGGTTTGAA		Hind III
SP082A	NO:365	CTGAGGATCCAATTGTACAATTAGAAAAAGATAGC		Bam HI
SP082B	NO:366	TGACAAGCTTGCCTTGACTAGGTTCTGCAATGCC		Hind III
SP083A	NO:367	GACTGGATCCTCTGACCAAGCAAAAAGAAGCAGTCAATGA		Bam HI
SP083B	NO:368	TCAGCAGCTGATCATTGACTTTACGATTTGCTCC		Bgl II
SP084A	NO:369	GACTGGATCCGTCGGGCTCTGTCCAGTCCACTTTTTTCAGCG		Bam HI
SP084B	NO:370	TCAGAAGCTTATTTTTTGTTCCTTAATGCGTT		Hind III
SP085A	NO:371	GACTGGATCCGGGACAAATTCAAAAAAATAGGCAAGAGG		Bam HI
SP085B	NO:372	GTCAAAGCTTTGGCTCTTTGATTGCCAACAACCTG		Hind III
SP086A	NO:373	GACTGGATCCTCGCTACCAGCAACAAAGCGAGCAAAAGG		Bam HI
SP086B	NO:374	GACTAAGCTTACTTTTTTCTTTTCCACACGA		Hind III
SP087A	NO:375	CAGTGGATCCGAACCGACAAGTCGCCCCTATCAAGACT		Bam HI
SP087B	NO:376	CTGAAAGCTTTGAATTCTCTTTCTTTTCAGGCT		Hind III
SP088A	NO:377	TCGAGGATCCGGTTGTCCGGCTGGCAATATATCCCGT		Bam HI
SP088B	NO:378	CAGTAAGCTTCCGAACCCATTGCGCATTATAGTTGAC		Hind III
SP089A	NO:379	AGTCGGATCCGGCCAAATCAGAATGGGTAGAAGAC		Bam HI
SP089B	NO:380	TGACCTGCAGCTTCTCATTGATTTTCATCATCAC		Pst I
SP090A	NO:381	GACTGGATCCATTGTCAGATGATTCTGAAGGATGG		Bam HI
SP090B	NO:382	TCAGCTGCAGCTTAACCCATTACCATTTAGTTTAAG		Pst I
SP091A	NO:383	GACTGGATCCTGTCGCTGCAATGAACTGAAGTAGC		Bam HI
SP091B	NO:384	GACTAAGCTTATACCAAACGCTGACATCTACGCG		Hind III
SP092A	NO:385	AGTCAGATCTTACGTCTCAGCCTACTTTTGTAAGAGC		Bgl II
SP092B	NO:386	GACTAAGCTTAAACCATTCACCATTTGGCATTGAC		Hind III
SP093A	NO:387	CAGTGGATCCTGGACAGGTGAAAGGTCATGCTACATTTGTG		Bam HI
SP093B	NO:388	GACTAAGCTTCAACCATTTGAGACCTTGCAACAC		Hind III
SP094A	NO:389	GTCAGGATCCGATTGCTCCTTTGAAGGATTTGAGAGAAACC		Bam HI
SP094B	NO:390	GACTAAGCTTCGATCAAAGATAAGATAAATATATATAAAGT		Hind III
SP095A	NO:391	GACTGGATCCTAGGTTCATATGGGACTTTTTTCTACAACAAAATAGG		Bam HI

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Table 3

Primer		<i>S. pneumoniae</i> ORF Cloning Primers	
Name	SEQ ID	Sequence	RE
SP095B	NO:392	TGACAAGCTTATCTATCAGCTCATTAAATCGTTTTTG	Hind III
SP096A	NO:393	CTGAGGATCCCAACGTTGAGAATTATTTGCGAATG	Bam HI
SP096B	NO:394	TGACAAGCTTGAGTCTACAAAAGTAATGTAC	Hind III
SP097A	NO:395	GTCAGGATCCCTACTATCAATCAAGTTCTTCAGCC	Bam HI
SP097B	NO:396	TGACAAGCTTGACTGAGGCTTGACCAGATTGAAAAG	Hind III
SP098A	NO:397	GACTGGATCCGACAAAACATTAAACGTCCTGAGG	Bam HI
SP098B	NO:398	GACTAAGCTTAGCACGAACGTGTGACGCTGGTTCC	Hind III
SP099A	NO:399	GACTGGATCCTTCTCAGGAGACCTTTAAAAATATC	Bam HI
SP099B	NO:400	GACTAAGCTTGTGGCCATCTTGACATACC	Hind III
SP100A	NO:401	GACTGGATCCAGTAAATGCGCAATCAAATTC	Bam HI
SP100B	NO:402	AGTCCTGCAGGTATTTAGCCCAATAATCTATAAAGCT	Pst I
SP101A	NO:403	CAGTGGATCCTTACCGCGTTCATCAAGATGTC	Bam HI
SP101B	NO:404	GACTAAGCTTGCCAGATGTTGAAAAGAGAGTG	Hind III
SP102A	NO:405	GACTGGATCCGTGGATGGGCTTTAACTATCTTCGTATTCCG	Bam HI
SP102B	NO:406	AGTCAAGCTTGCTAGTCTTCACTTTCCCTTTCC	Hind III
SP103A	NO:407	GACTGTCGACACTAAACCAGCATCGTTTCGCAGGA	Sal I
SP103B	NO:408	CTGACTGCAGCTTCTTGAAGAAATAATGATTGTGG	Pst I
SP105A	NO:409	CAGTGGATCCTGACTACCTTGAAATCCCACCTT	Bam HI
SP105B	NO:410	CAGTAAGCTTTTTTTTAAAGGTGTAGAATGATTTCAATC	Hind III
SP106A	NO:411	CAGTGTGCACTCGTATCTTTTTTTGGAGCAATGTT	Sal I
SP106B	NO:412	GACTAAGCTTAAATGTTCCGATACGGGTGATTG	Hind III
SP107A	NO:413	CAGTGGATCCGGACTCTCTCAAAGATGTGAAAG	Bam HI
SP107B	NO:414	GACTAAGCTTCTTGAGTTTGTCAAGGATTGCTTT	Hind III
SP108A	NO:415	CAGTGGATCCCAAGAAATCTATCATCTCTTCCAGAAG	Bam HI
SP108B	NO:416	GACTAAGCTTTTCAGAACTAAAAGCCGCAGCTT	Hind III
SP109A	NO:417	GACTGGATCCACGAAATGCAGGGCAGACAG	Bam HI
SP109B	NO:418	CAGTAAGCTTATCAACATAATCTAGTAAATAAGCGT	Hind III
SP110A	NO:419	CAGTGGATCCTGTATAGTTTTTAGCGCTTGTTCTTC	Bam HI
SP110B	NO:420	GTCAAAGCTTTGATAGAGTGTCAATCTTCTTTAG	Hind III
SP111A	NO:421	GACTGGATCCGTGTGTCGAGCATATTCTGAAG	Bam HI
SP111B	NO:422	CAGTAAGCTTACTTTTTACCATTCTTTGTTCTGCATC	Hind III
SP112A	NO:423	GACTGTCGACGTGTTTGGATAGCATTGAGAATCAGACG	Sal I
SP112B	NO:424	CAGTAAGCTTCGGAAGTAAAGACAATTTTTTCC	Hind III
SP113A	NO:425	CAGTGGATCCGTGCCTAGATAGTATTATTACTCAAAC	Bam HI
SP113B	NO:426	GACTAAGCTTTTTTGCTTATTTCTCTCAATTTTTTC	Hind III
SP114A	NO:427	CAGTGGATCCCATTCAGAAGCAGACCTATCAAAATC	Bam HI
SP114B	NO:428	ACTGAAGCTTATGTAATTTTTTAGATTTTTCAATATTTTCAG	Hind III
SP115A	NO:429	AGTCGGATCCTAAGGCTGATAATCGTGTTCAAATG	Bam HI
SP115B	NO:430	GACTAAGCTTAAAATTAGATAGACGTTGAGT	Hind III
SP117A	NO:431	AGTCGGATCCCTGTGGCAATCAGTCAGCTGCTTCC	Bam HI
SP117B	NO:432	GACTGTCGACTTTAATCTTGTCCCAGGTGGTTAATTTGCC	Sal I
SP118A	NO:433	ACTGGTCGACTTGTCAACAACAACATGCTACTTCTGAG	Sal I
SP118B	NO:434	GACTCTGCAGAAGTTTAACCCACTTATCATTATCC	Pst I
SP119A	NO:435	ACTGGGATCCTTGTTTCAGGCAAGTCCGTGACTAGTGAAC	Bam HI
SP119B	NO:436	GACTAAGCTTGGCTAATTCCTTCAAAGTTTGCA	Hind III
SP120A	NO:437	AGTCGGATCCCTCGCAAATGAAAAGGCGGCAGTTAGCC	Bam HI
SP120B	NO:438	GACTAAGCTTGTAATAAGCGTACCTTTTTCTTCC	Hind III
SP121A	NO:439	TCAGGGATCCTTGTCAGTCAGGTTCTAATGGTTCTCAG	Bam HI
SP121B	NO:440	AGTCAAGCTTGGCATTGGCGTCGCCGTCCTTC	Hind III
SP122A	NO:441	GACTGGATCCGGAACTTCACAGGATTTTAAAGAGAAG	Bam HI
SP122B	NO:442	GACTGTCGACAATCAATCCTTCTTCTGCACTTCT	Sal I
SP123A	NO:443	CAGTGGATCCTGTGGTCAAGTTGAGACTCCTCAATC	Bam HI
SP123B	NO:444	GACTAAGCTTTTCTTCAAATTTATTATCAGC	Hind III
SP124A	NO:445	AGTCGGATCCAACACCTGTATATAAAGTTACAGCAATCG	Bam HI
SP124B	NO:446	GACTGTCGACTACTTGACCGAATGCGTCAATGTACG	Sal I

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Table 3

*S. pneumoniae* ORF Cloning Primers

Primer				
Name	SEQ ID	Sequence		RE
SP125A	NO:447	CTGAGGATCCATTAGACAGATTAATTGAAATCGG		Bam HI
SP125B	NO:448	GACTGTCGACTTTAAAGATTGAAGTTTTAAAGCT		Sal I
SP126A	NO:449	TGACGGATCCTAAGACAGATGAACGGAGCAAGGTG		Bam HI
SP126B	NO:450	CTGAAAGCTTTAAGGCTTCCTCAATGAGTTTGTCT		Hind III
SP127A	NO:451	GACTGGATCCCTGTGAGAATCAAGCTACACCCA		Bam HI
SP127B	NO:452	CTGAAAGCTTTTGTAAGTGAAGATTGATCTGGGAG		Hind III

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